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DEPARTMENT OF  
CONSERVATION AND  
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Cover

*Nuytsia floribunda* (Labill.) R. Br. ex Fenzl (Loranthaceae) - the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the "Gulde Zeepard" on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

## **The *Hakea pedunculata* group of species (Proteaceae) and a new subspecies of *Hakea stenophylla* from Western Australia**

R.M. Barker

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### **Abstract**

R.M. Barker. The *Hakea pedunculata* group of species (Proteaceae) and a new subspecies of *Hakea stenophylla* from Western Australia. Nuytsia 12 (1): 1-8 (1998). The informal "Pedunculata" group of *Hakea* consists of four species from northern Australia, *H. arborescens* R. Br., *H. pedunculata* F. Muell., *H. persiehana* F. Muell. and *H. stenophylla* A. Cunn. ex R. Br. A key to the species is provided together with a discussion of relationships within the group. Each species is typified and a new subspecies, *H. stenophylla* subsp. *notialis* R.M. Barker, is described from Western Australia.

### **Introduction**

In the forthcoming treatment of *Hakea* Schrad. (Proteaceae) for the "Flora of Australia" (R.M. Barker, W.R. Barker & L. Haegi in press), the species are arranged in informal groups since the infrageneric classification is still being tested and modified. This work presents a key to the group of species of *Hakea* known as the "Pedunculata" group, typifies each of the species and describes a new subspecies of *H. stenophylla*.

### ***Hakea pedunculata* group**

The Pedunculata group of *Hakea* species is distinctive in having an axillary peduncle below the terminal buds or flowers. In all other species of *Hakea* the flower-bearing rachis arises directly from the axil and has flowers along its full length, but in this group of species there is a distinct non-flowering portion which has been designated as the peduncle. The peduncle is initially simple in all species, but may have two or three buds capable of developing further to produce a branched peduncle.

The group is further defined by being small trees or, more rarely, shrubs often with thick corky bark, obscure venation on the simple flat or terete leaves and large, distinctly woody and tardily dehiscent fruits which are retained on the plant on a much thickened rachis. These fruits are neither horned nor beaked, but they are apiculate and usually only one develops from each inflorescence. The only other *Hakea* group to be small trees with thick corky bark and occupying the same area as the *H. pedunculata*

group is the group commonly known as the Corkwoods. These are easily distinguished from the *H. pedunculata* group since they produce multiple fruits from the one inflorescence. These fruits are not noticeably woody and at maturity they open readily and are not retained on the plant.

Three of the species belonging to the Pedunculata group, *H. pedunculata*, *H. persiehana* and *H. arborescens* occur in northern tropical Australia, with the first two confined to northern Queensland and *H. arborescens* occurring in all three states. *H. stenophylla* is confined to Western Australia in the region between Onslow and the Murchison River.

Within the group there are two species pairs based on the size and the nature of the indumentum of the perianth, pistil length and pollen presenter shape (see Table 1).

*H. arborescens* and *H. persiehanas* have the same pollen presenter shape of an almost erect cone. They also have tiny flowers in which the perianth claw has white hairs in contrast to the rust-coloured hairs of the limb and both species have very short pistils. Although not indicated in the table, both also have short simple hairs at the base of the style, a characteristic otherwise unknown in *Hakea*. They can be distinguished from each other by the flat leaves of *H. arborescens* compared with the terete leaves of *H. persiehana*, but it is possible that this difference may break down in areas of overlap in the Chillagoe-Mareeba area of Queensland and this needs to be investigated further.

*Hakea stenophylla* and *H. pedunculata* have much longer pistils than the other pair of species and have the same pollen presenter shape - an oblique disc with a tiny central cone. The hairs on the perianth are usually white throughout, although they are sometimes only very sparse on the claw of *H. pedunculata*. While the perianth length measurement given in the table appears not to support it, the mature flowers are also much larger for *H. stenophylla* and *H. pedunculata* compared with the other two species. To achieve comparable perianth lengths across all of the *Hakea* species for the revision it was decided to measure perianth length at the point when the style was just about to break out from the tepals, but in these (and other) species this has proved not to be a good indication of the final flower size. The length of the pistil is a much better indicator.

Table 1. Comparison of the four species of the *Hakea pedunculata* group

Taxon	Leaves	Pollen presenter	Pistil length (mm)	Perianth length (mm)	Hairs on claw	Hairs on limb
<i>H. stenophylla</i>	flat	oblique disc	7-13	1.6-4	white	white
<i>H. pedunculata</i>	flat	oblique disc	8.5-12	3.5-4	± lacking	white
<i>H. persiehana</i>	terete	conical sub-erect	1.5-2	2-2.5	white	rust
<i>H. arborescens</i>	flat	conical sub-erect	1.5-2.5	2-2.5	white	rust

*H. stenophylla* and *H. arborescens* have often been confused in the past but they are clearly distinct species since they differ in flower size, branching of the peduncle and pollen presenter morphology. However, unless flowers are present, difficulty can be experienced in distinguishing between them since they do overlap in leaf size and the fruits are not always easily distinguishable. The blackened apex and



slightly smaller size and smoothness of fruits of *H. stenophylla* are not always easily recognized without comparative material. The apex of the fruit in *H. stenophylla* is abruptly acuminate in median view (fruit viewed with suture not visible) while that of *H. arborescens* is usually gradually attenuate, but may occasionally be abruptly acuminate. Peak flowering for *H. arborescens* is from November to March but there are sporadic records up to as late as June, while that for *H. stenophylla* is May to August. There appears to be no overlap in distribution, since *H. arborescens* occurs north of 20° latitude in all three states and *H. stenophylla* well south of 21° latitude in Western Australia.

### Key to species of the *Hakea pedunculata* group

- 1 Flowers white-pubescent on pedicel and claw, ferruginous on limb;  
pollen presenter a sub-erect cone; pistil 1.5-2.5 mm long
- 2 Leaves flat, linear to narrowly obovate, 1-9 mm wide; shrub or  
small tree to 7 m high [tropical NT, Qld, WA; flowers Nov.-Mar.  
with sporadic occurrences up to June] ..... **1. *H. arborescens***
- 2: Leaves terete, 0.7-1 mm wide; tree to 10 m high [Cape York Peninsula,  
Atherton region and north; flowers Nov.-Mar. with sporadic  
occurrences up to June] ..... **2. *H. persiehana***
- 1: Flowers with only white hairs, these sometimes lacking on pedicel and  
claw; pollen presenter an oblique disc; pistil 7-13 mm long
- 3 Leaves narrowly to broadly obovate, 8-25 mm wide; peduncle subglabrous,  
not branched; branchlets glabrous; claw of perianth glabrescent,  
limb pubescent; fruit 2-3 cm long, 1-1.2 cm wide; seed occupying whole  
valve [mangrove or swamp areas of Cape York Peninsula, N of Cooktown;  
flowers Apr.-Aug., rarely as early as Feb.] ..... **3. *H. pedunculata***
- 3: Leaves linear to narrowly obovate, 1-4(15) mm wide; peduncle  
white-pubescent, often branched; branchlets appressed-pubescent;  
claw and limb of perianth pubescent; fruit 3-4.5 cm long, 2-2.6 cm wide;  
seed not occupying whole valve [Onslow to Murchison River, WA;  
flowers May-Sep.] ..... **4. *H. stenophylla***

**1. *Hakea arborescens*** R. Br., Trans. Linn. Soc. 10: 187 (1810). *Type citation*: “Carpentaria, in apricis prope littora.” *Citation in Brown’s unpublished manuscript*: “Island c [Allen Island], Nov. 20-21 1802, R. Brown no. 7”, but he also adds “Islands a [Swee’s], b [Bentinck], c [Allen]” at the end of the description.

*Lectotype here designated*: Carpentaria, South Wellesley Islands, Islands a [Sweers], b [Bentinck] and c [Allen], [Qld], 17-27 Nov. 1802, *R. Brown, P. Good & Allen* no. 7 [*J.J. Bennett* no. 3362], (BM *p.p.*, 2 upper narrow-leaved specimens only) - Robert Brown’s annotations on the lectotype specimen: **Label 1** (attached to blue J.J. Bennett numbered label bearing number 3362): “35 *Hakea arborescens* Prodr. 386/No. 7 desc post Carpentaria, Islands a,b,c, Novr 17-27, 1802”; **Label 2**: “Conchium, island y l [Cotton Island], Feby 20th 1803, ad later collium/arbor parv., c[ort]: rimoso, fructu Conchii arborescentes a quo [vix] diversum/ Flores non visi/ *H. arborescens* var?”; *isolectotypes*: North Coast, *s.dat.*, *R. Brown s.n.* (B ex Herb. K 1882); without locality, *s.dat.*, *R. Brown s.n.* (B, Brown ded. 1816); North Coast [Carpentaria, Wellesley’s Islands, Nov. 1802 on typewritten label], *s.dat.*, *R. Brown s.n.* (BM); Islands of S of Carpentaria, 1802-5, *R. Brown* [*J.J. Bennett* no. 3362] *s.n.* (E, presented 1876); North Coast, 1802-5, *R. Brown* [*J.J. Bennett* no. lacking] *s.n.* (E); North Coast, *s.dat.*, *R. Brown s.n.* (K *p.p.* received from J.J. Bennett Aug. 1880); North Coast, *s.dat.*, *R. Brown s.n.* (MEL 108133 *p.p.*, NSW 131414);

Carpentaria, 1802-3, *R. Browns.n.* (P-herb. Richard); Iter Austr., 1802-5, *R. Browns.n.* (NSW 179418, NY ex E); *syntypes*: North Coast, *s.dat.*, *R. Browns.n.* (MEL 108133 *p.p.* excluding RHS specimen); without locality, *s.dat.*, *R. Brown* [J.J. Bennett no. 3362] *s.n.* (K *p.p.* presented 1876); [NT]; The English Company's Is, Island y1 [Cotton], 20 Feb. 1803, *R. Browns.n.* (BM *p.p.*).

*Typification.* Since the protologue is apparently drawn up from material collected by Brown, Good and Allen from Islands a, b and c between 17 and 27 November, 1802, there are a number of collections involved. There appear to be 3 collections on the lectotype sheet in BM:

Collection 1: The upper 2 branches, which have narrow leaves and flowers predominantly at bud stage. Specimens in B (2 sheets), E (2 sheets), P, the second BM sheet and the top right hand specimen in K and MEL would appear to match this.

Collection 2: The lower 2 branches which have wider leaves; both are at a similar stage of flowering. The majority of specimens (7 branches) on the MEL sheet appear to match this as do possibly the 2 left hand specimens on the sheet in K.

Collection 3: A single fruit to which label 2 apparently applies, collected on 20 Feb. 1803, from island y1. This fruit is not considered to be part of the lectotype since Brown described the fruit in his manuscript based on collections from islands a, b and c, not island y1. The single fruit on the K sheet may be part of the gathering from island y1, but since it is mounted with a narrow-leaved branch it could well represent the only fruit which has survived from the collections from islands a, b and c.

Label 1, indicating that the specimens are from islands a, b and c, would appear to apply to collections 1 & 2 distinguished here. Brown collected on islands a and c but only Good and Allen collected on island b (Vallance 1990). There is no way of distinguishing individual collections or which specimen belongs to which island. The narrow-leaved collection (collection 1) has been designated as lectotype since it is represented in many more herbaria than the wider-leaved collection 2.

*Note.* *Hakea arborescens* is possibly not specifically distinct from the next species, *H. persiehana*, since the two appear to differ only in the flat versus terete leaves. Field work in the overlap area is needed to resolve this problem.

## 2. *Hakea persiehana* F. Muell., Australasian J. Pharmacy 1 (11): 430 (1886).

*Lectotype here designated:* Endeavour River, 1883, *W. Persieh s.n.* (MEL 1536632); *probable isolectotypes:* Without locality, *s.dat.*, *Anon.* 1139 (MEL 1536628); Endeavour River, *s.dat.*, *W. Persieh s.n.* (B-herb. Diels 7890, ex herb. MEL); *syntypes:* Endeavour River, 1885, *W. Persieh* 573 (MEL 1536631); Endeavour River, 1886, *W. Persieh* 573 (MEL 1536630); *probable syntypes:* Endeavour River, 1886, *W. Persieh s.n.* (MEL 1537930 *p.p.*, not including fruit); Endeavour River, 1886, *W. Persieh* 757/725, (MEL 1536629); Endeavour River, 1886, *W. Persieh s.n.* (BM, K *p.p.*); *isosyntype* (part of the original collection, but not seen by Mueller for drawing up the protologue since it has mature fruits): Endeavour River, 1886, *W. Persieh* 725 (MEL 1537888); *possible isosyntype:* Endeavour River, 1886, *W. Persieh s.n.* (MEL 1537930 *p.p.*, fruit only).

*Typification.* The lectotype sheet consists of three flowering branches mounted with Mueller's description of the characteristics of the inflorescence, the rachis, petals, stigma and gland. These descriptions closely match those within the protologue. Neither of the probable isolectotypes has been

annotated by Mueller but the material closely matches that found on the lectotype. The sheet, *Anon.* 1139, contains an immature fruit within the envelope and this is presumably that referred to by Mueller in the protologue. The syntype sheets each consist of single flowering branches, apparently collected in 1885 since the date on MEL 1536631 has been changed from 1886 to 1885. The same change does not appear on the other sheet.

The probable syntypes (MEL 1537930 *p.p.* & MEL 1536629) were apparently both received by Mueller before the protologue since specific mention is made of them by Persieh in a letter to Mueller of November 21st, 1886 (mounted on MEL 674673 and translated by Doris Sinkora). Persieh thanked Mueller for his “favour of 3rd and 4th [November] inst.” which possibly refers to a copy of the protologue since he thanked Mueller for naming “this pretty *Hakea* after your humble servant”. He further mentioned that he sent “with those specimens branches and fruits No. 725 and 757, each time with a branch and fruit”. The probable syntype specimen labelled 757/725 has no fruits present, but has been annotated by Mueller as “*Hakea Persiehana*” while the other sheet, which bears no number, matches the material on this sheet. *Persieh* 725 (MEL 1537888) can only be treated as isosyntype material since it bears mature fruits; in the protologue Mueller specifically mentioned only having seen immature fruits. The mature fruit in the envelope mounted on MEL 1537930 may have come from the collection *Persieh* 725 and thus be isosyntype material or it may be from the same gathering as that mounted on MEL 674643 which was sent in November or December 1886 and consists of fruits without any leaves. This was received too late to be considered part of the protologue, although the letter attached to it is invaluable in helping to identify type material.

The material in K and BM matches closely that specimen in MEL which has been labelled 757/725 and so almost certainly represents syntype material. The fruit on the K sheet cannot be considered as part of the type material since it is mature and much larger than the immature one cited in the protologue.

**3. *Hakea pedunculata*** F. Muell., *Australasian Chemist & Druggist* 6 (63): 23 (1883). *Lectotype here designated*: Endeavour River, 1883, *W. Persiehs.n.* [1031] (MEL 1537929); *isoelectotypes*: K (received 8.1883), BRI 259703; *possible isoelectotypes*: BRI 260982, K.

*Typification.* The lectotype sheet consists of five small branches with flowers or remnants of them and two fruits within a packet. The material in K labelled as a possible isoelectotype consists of a small flowering branch which more or less resembles the lectotype collection but it is labelled as being received in December 1886 and is not annotated by Mueller. The BRI sheet labelled as a possible isoelectotype matches the type material in that it is flowering and fruiting, but there is no date and no obvious evidence that it was seen by Mueller although some of the annotations on the original label are possibly by him. Another Persieh collection, BRI 358426, is not considered to be part of the type gathering since the branch is much larger and more robust than those of the type and it is not flowering or fruiting; it was not annotated by Mueller.

**4. *Hakea stenophylla*** A. Cunn. ex R. Br., *Suppl. Prodr. Fl. Nov. Holl.* 30 (1830). *Type citation*: “Ora septent. -occid., Bay of Rest, 1818, D. Cunningham”.

*Lectotype here designated*: On red sandy flats in the vicinity of the Bay of Rest in Exmouth Gulf on the North West Coast of Australia/*Hakea stenophylla* C[unningham]. Bay of Rest, Red sandy flats, Feby 16. 1819 [1818], no. 109, 1st Voyage [all in Brown's hand], [*A. Cunningham*] (BM); *isoelectotypes*: *Hakea stenophylla* Cunn.” Br. A small Tree 12-15 ft high/arid sands/Bay of Rest N. W. Coast/ Lat. 22 [degrees] 17 [minutes] S, Long. 114 [degrees] 20 [minutes] E/ Feb. 109/1818/ 108?/1 Voy, *A. Cunningham* (K *p.p.* herb. Cunningham); Bay of Rest, N.W. Coast, *s.dat.*, *Anon.* [*A. Cunningham*] *s.n.* (K *p.p.*); *Hakea stenophylla* Cunn. [Cunningham] no. 109, Mermaids 1st Voy!, Bay of Rest (B)

*Typification.* The lectotype consists of two branches, both with fruit but lacking any flowers as might be expected for February. It bears a label annotated by Brown. Since there is no way of knowing whether Brown saw the other Cunningham material in drawing up the protologue this sheet has been designated lectotype, even though it may well be the holotype.

*Notes.* A new subspecies of *H. stenophylla* is described below, although it is felt that further research may show this subspecies to be worthy of specific rank. As discussed in more detail in the notes under the two subspecies, it appears that they differ in habit and possibly habitat, (but notes on some specimens do not support this), perhaps also in presence or absence of a lignotuber and possibly in branching of the peduncle (but there is too little flowering material of subsp. *stenophylla* to confirm this). For the moment they can only be definitely distinguished with fruiting material, but even this is not always reliable and hence the subspecies status.

#### Key to subspecies of *Hakea stenophylla*

- 1 Spreading shrub, usually less than 2 m tall; fruiting valve with red-brown wood zone 1.5-2.5 mm wide, pale wood zone 3-6 mm wide; seed covering *c.* three quarters valve surface; fruit apex erect, or if recurved, usually recurved away from red-brown layer of valve ..... subsp. *stenophylla*
- 1: Erect shrub or small tree to 4 m high; fruiting valve with red-brown wood zone 2.5-4 mm wide, pale wood zone 8-10 mm wide; seed covering *c.* half valve surface; fruit apex erect or, if recurved, usually recurved towards red-brown layer of valve ..... subsp. *notialis*

#### 4a. *Hakea stenophylla* A. Cunn. ex R. Br. subsp. *stenophylla*

Low spreading shrub, 0.5-2(5) m high, up to 2 m wide. *Peduncle* branched or not. *Perianth* 2.5-4 mm long. *Fruit* with apex erect or, if recurved, usually recurved away from red-brown wood zone (except for *Phillips* 28) of valve; valve with red-brown wood zone 1.5-2.5 mm wide, pale wood zone 3-6 mm wide, seed covering *c.* three quarters valve face.

*Selected specimens examined.* WESTERN AUSTRALIA: On the Exmouth-Minilya Highway, *c.* 99.5 km by road N of Minilya road-house, *c.* 15.1 km by road N of turnoff to Coral Bay (near Point Maud), 5 Sep. 1995, *W.R. Barker* 7402 (AD, duplicates to be distributed); 20 miles [32 km] S of Minilya River, North West Coastal Highway, 1 Sep. 1960, *A.S. George* 1460 (PERTH); Cape Range National Park; Oil Well No. 2, at W end of Charles Kniferoad, *c.* 11 km by road WNW of Exmouth-Carnarvon road, 29 Aug. 1977, *E.N.S. Jackson* 3065 (AD); 15 km E of Onslow, 27 June 1976, *A.A. Mitchell* 76/154 (PERTH); Dorre Island, Shark Bay, 15 July 1959, *R.D. Royce* 5904 (PERTH).

*Distribution and ecology.* Subsp. *stenophylla* is found in the Cape Range to Minilya River area of Western Australia, and also on Dorre Island in Shark Bay (see notes). It may also occur in the Murchison River area where subsp. *notialis* is more usually found (*q.v.*). It grows in red sand hills or coastal sand dunes, usually with spinifex.

*Flowering period.* May to September.

*Notes.* The specimen *Royce* 5904 from Dorre Island is non-flowering but has a fruit which places it with subsp. *stenophylla*. The plant is recorded as a low windswept shrub about 45 cm high and has much

wider (7-15 mm wide) and thicker leaves than are usually encountered within this taxon. These leaf characteristics can presumably be attributed to the windswept habitat

Notes on the collection *Barker 7402*, record the specimens as coming from multi-stemmed shrubs shooting from the base, suggesting that subsp. *stenophylla* is lignotuberosus. The erect habit of subsp. *notialis* could indicate that that subspecies is non-lignotuberosus, but this should be investigated further.

The habit difference cited in the key seems to apply in the majority of cases but it should be noted that the type specimen has been annotated by Cunningham as coming from a small tree 12-15 feet [3.5-4.5 m] high, and so this character needs to be treated with caution.

#### 4b. *Hakea stenophylla* subsp. *notialis* R.M. Barker, *subsp. nov.*

*Hakea stenophylla* "Murchison" (*G. Phillips 27*), manuscript designation used on PERTH collections.

Subspecies nova *Hakeae stenophyllae* sed differt a subsp. *stenophylla* valvae fructus zona rubro-brunneo 2.5-4 mm latoa, zona pallido 6-10 mm latoa et semine c. dimidioum valvae faciei tegenti.

*Typus*: White flowers, insignificant. Large fruits, tree 15 ft, leaves hooked on end. Sandplain yellow. Vegetation 15-20 ft and prolific. Murchison sandplain, 320 mile post, North West Coastal Highway, Western Australia. 20 July 1972, *G. Phillips 27* (*holo*: PERTH 1983547; *iso*: K, NSW, NT).

Erect *shrub* or small *tree*, 2-4 m high. *Peduncle* always 2-3-branched. *Perianth* 1.6-2.5 (?4) mm long. *Fruit* with apex erect or recurved towards red-brown wood zone (except *Smith 1682*) of the valves; valve with red-brown wood zone 2.5-4 mm wide, pale wood zone 6-10 mm wide, seed covering c. half valve face.

*Specimens examined*. WESTERN AUSTRALIA: Shark Bay, Oct. 1877, *Anon. (Herb. Mueller) s.n.* (MEL 108016); 37 miles [59 km] S of Denham, July 1970, *T.E.H. Aplin 3356* (AD, PERTH); 35 km NE of Kalbarri, 19 May 1968, *J. Bannister s.n.* (PERTH); between Hamelin and Tamala, 10 Oct. 1973, *J.S. Beard 6787* (NSW, PERTH); 392 mile peg on North West Coastal Highway, 30 Oct. 1966, *A.C. Burns 1060* (PERTH); 414 mile post on Great Northern Highway [North West Coastal], 15 May 1968, *H. Demarz 87* (PERTH); 413.5 miles [c. 668 km] along Great Northern Highway [North West Coastal], 7 Aug. 1969, *H. Demarz 1485* (CANB, PERTH); Murchison River, 6 Jan. 1961, *C.A. Gardner 12294* (PERTH); 32 miles [51 km] N of Murchison River, North West Coastal Highway, 18 Feb. 1962, *A.S. George 3240* (PERTH); 135 km N of Northampton on Carnarvon Road, 14 July 1964, *D.W. Goodall 1196* (PERTH); 20 km W of Hamelin Homestead, *T.J. Hawkeswood 59* (PERTH); Carnarvon-Geraldton Highway, 8 Aug. 1965, *F. Humphreys s.n.* (PERTH); 410 mile peg, Carnarvon Highway, 19 Dec. 1962, *F. Lullfitz 1969*, (KINGS PARK, PERTH); 34 miles [54 km] S of Wannoo (near 422 mile post), 17 Sep. 1968, *M.E. Phillips s.n.* (CANB, NSW); 85 miles [136 km] N of Murchison River Bridge, Great Northern Highway [North West Coastal], 12 July 1959, *R.D. Royce 5850* (PERTH); 392 mile peg N of Murchison River, 9 July 1963, *F.G. Smith 1682* (PERTH); Tamala Station, May 1960, *R.W. Vollprecht s.n.* (PERTH).  
*Specimen examined with affinities to subsp. notialis* (see notes): Murchison Bridge, 380 mile post North West Coastal Highway, *G. Phillips 28* (CANB, MEL, NT, PERTH).

*Distribution and ecology*. Subspecies *notialis* is found in the area between Carnarvon and the Murchison River in Western Australia. Some of the earlier-collected specimens record it from the Great Northern Highway but these are actually from what is now known as the North West Coastal Highway. It grows in sandplain or heath.

*Flowering period.* Flowers May to August.

*Etymology.* From *notialis*, the Latin equivalent for southern, in reference to the fact that this subspecies occupies the southern portion of the distribution of *H. stenophylla*.

*Notes.* The collection *Phillips* 28 from the Murchison River area, where subsp. *notialis* is the usual taxon found, has the fruit valve with a red-brown wood layer 2.5-3 mm wide and the apex recurved towards this red-brown layer as in typical subsp. *notialis*. However, the seed occupies more than half of the valve and the white wood layer is less than 6 mm wide, characteristics of subsp. *stenophylla*. Similarly recurvature of the apex in the fruit of *Smith* 1682 which belongs with subsp. *notialis* is away from the red-brown wood zone, which is more characteristic of subsp. *stenophylla*. It may be that the direction of recurvature of the apex is not a reliable character for separating the taxa and the width of the pale wood may be modified with further collections.

### Acknowledgements

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### References

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## A trial key and notes on *Tribulus* (Zygophyllaceae) in Australia, including one new species and validation of *Tribulus suberosus*

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### Abstract

R.M. Barker. A trial key and notes on *Tribulus* (Zygophyllaceae) in Australia, including one new species and validation of *Tribulus suberosus*. Nuytsia 12 (1): 9-35 (1998). A trial key is presented to those species of *Tribulus* L. which occur in Australia, together with notes on the taxonomy and biology of these species. Taxonomy of the native species which are not related to *T. terrestris* L. is clear cut, apart from the addition of a new species, *T. adelacanthus* R.M. Barker, most closely related to *T. hirsutus* Benth. and *T. macrocarpus* F. Muell. ex Benth. In contrast, the taxonomy of those species surrounding the *T. terrestris* complex is sorely in need of a world revision. Two taxa are informally described from within that group and there is a discussion of the taxa in the *T. terrestris* complex. *T. suberosus* H. Eichler ex R.M. Barker is validated and lectotypes are designated for several species.

### Introduction

The taxonomy of *Tribulus* L. (Zygophyllaceae) is very much in need of a detailed revision world-wide, particularly of those species with spiny cocci i.e. *T. terrestris*, *T. cistoides*, *T. occidentalis*, *T. hystrix* and related species. The classification presented here is the traditional approach taken to the genus for a number of years but the author has often had difficulty in satisfactorily delimiting the taxa of the *T. terrestris* complex, and in distinguishing between *T. cistoides* and *T. eichlerianus*, *T. cistoides* and *T. occidentalis* and between *T. occidentalis* and *T. hystrix*. Most fruiting specimens can be assigned to a taxon but there are specimens which erode the differences between species, such that it is often difficult to find reliable distinguishing characters. A number of possibilities could explain this:

1. There are more or less taxa present here in Australia than the present classification suggests.
2. Hybridization is occurring between taxa which were previously geographically isolated.
3. Morphological expression is very plastic and much influenced by environment.

Until there is a better understanding of the biology of these mostly introduced species, combined with field studies, it is unlikely that a stable classification can be achieved. There is particular difficulty with specimens from the north-western areas of Western Australia where a number of species overlap in distribution and there are, as a consequence, a number of collections which cannot be satisfactorily placed at the species level. Even being able to identify those taxa which have been introduced may help considerably in understanding the taxonomy of this group. For example, at the moment it is considered that some of the taxa in the *T. terrestris* group are native, but this may not be the case. The smaller, more

or less unarmed cocci of *T. minutus* and *T. micrococcus*, both considered to be native to Australia, could well relate to *T. terrestris* var. *inermis* Boiss. or var. *bicornutus* (Fisch. & C.A. Meyer) Hadidi as depicted in the treatment of Zygophyllaceae (El Hadidi 1972) in “Flora Iranica”. In contrast to the complexities within section *Terrestris*, the other native Australian species are usually easily distinguishable.

The purpose of this paper is to provide an overview of *Tribulus* in Australia, to highlight the problems and to provide an interim working key to taxa.

**Generic and infrageneric considerations**

All of the species of *Tribulus* (and *Tribulopsis* R. Br.) in Australia were transferred to *Kallstroemia* Scop. by Engler (1890). One species, *T. platypterus*, presumably because of its bushy habit where all other species were prostrate, continued to be referred to *Kallstroemia* even after the rest had been transferred back to *Tribulus*.

Porter (1971) in his notes on the floral glands of *Tribulus* indicated that “the principal diagnostic floral characters distinguishing *Tribulus* from the closely related genus *Kallstroemia* Scop., with which it is often confused, is the presence of a whorl of five intrastaminal glands at the base of the ovary in *Tribulus*”. These intrastaminal glands are unmistakably present in the species surrounding the *T. terrestris* complex and in the other spiny-fruited *Tribulus* species whose taxonomy is not clear cut as discussed above. These glands are absent in the native Australian species, *T. suberosus*, *T. platypterus*, *T. forrestii*, *T. astrocarpus*, *T. hirsutus* and *T. macrocarpus*, raising the possibility that they might be more appropriately treated as *Kallstroemia* than *Tribulus*. However, *Kallstroemia* is further characterized by a 10-lobed stigma and fruit and a 10-lobed disc upon which the 5 stamens are attached, all characters not applicable to the endemic Australian species. Thus it seems likely that the native Australian species could well form their own section within *Tribulus* based on the lack of the intrastaminal glands.

This approach would not be supported by El Hadidi’s (1978) classification where he proposed three sections for *Tribulus*, based on fruit morphology. Section *Terrestris* consisted of all of the species within the *T. terrestris* complex and *T. astrocarpus*, section *Alata* of those species with winged carpels and section *Inermis* of species with unarmed and unwinged fruits. He further suggested that *T. platypterus* might represent a new genus because of its unique shrubby habit. Based on his classification the Australian species would be disposed as in Table 1.

Table 1. Placement of the Australian species of *Tribulus* in the sections recognized by El Hadidi (1978).

section <i>Terrestris</i>	section <i>Inermis</i>	section <i>Alata</i>
<i>T. terrestris</i> complex	? <i>T. forrestii</i> F. Muell.	<i>T. platypterus</i> Benth.
<i>T. hystrix</i> R. Br.		<i>T. suberosus</i> H. Eichler ex R.M. Barker
<i>T. occidentalis</i> R. Br.		<i>T. macrocarpus</i> F. Muell. ex Benth.
<i>T. eichlerianus</i> K.L. Wilson		? <i>T. hirsutus</i> Benth.
<i>T. cistoides</i> L.		
<i>T. astrocarpus</i> F. Muell.		



There are problems with this classification when applied to the Australian species. *T. forrestii* agrees closely with the fruits of *T. kaiseri* H. Hosni pictured by El Hadidi (1978) as representative of section *Inermis*, except that it does possess a pair of median spines. Similarly some of the forms of *T. terrestris* in Australia, referred to *T. micrococcus* and *T. minutus*, are almost without spines and approach section *Inermis*. *T. forrestii* would appear to differ from all species within section *Terrestris* and section *Inermis* by the lack of the intrastaminal glands. *T. astrocarpus* was placed by El Hadidi in section *Terrestris* but as stated above, it lacks the intrastaminal glands of that group.

There is also variation within the Australian species assigned to section *Alata*. While *T. platypterus* and *T. suberosus* have clearly winged fruits which agree well with the fruits of this section, their shrubby habit is at odds with the more usually prostrate species of *Tribulus*. The fruits of *T. hirsutus*, while clearly winged in the dry state, seem to be derived by a different process to the other winged fruits. In their fresh state, fruits of *T. hirsutus* appear much more like the fruits of section *Inermis* since the walls are greatly inflated. It is only on drying that these walls collapse in on each other to give a winged appearance. *T. macrocarpus*, also assigned to this section, has a pair of median spines between the wings of each carpel. *T. astrocarpus* was placed in section *Terrestris* by El Hadidi although its relationships would appear to be with *T. macrocarpus* if the author has correctly interpreted the structure of the fruit of the newly described *T. adelacanthus* (see below).

In the forthcoming treatment for the "Flora of Australia", the species have been placed in informal groupings based on a number of characters, including habit, sepal characters, presence or absence of intrastaminal glands and fruit characters. The position of the endemic Australian genus *Tribulopsis*, sometimes included in *Tribulus*, also requires further study, but for the purposes of this paper it is treated as a distinct genus.

## Biology

### Longitudinal rolling of petals

It is quite noticeable that the petals of most, if not all, *Tribulus* species in Australia are widespread and plate-like in open flower, but when the flower closes the petals roll up longitudinally and stand erect about the centre of the flower. The reason for this characteristic is not known. It may be a signal that the flower is finished, it may be a means of surrounding the stigma by the stamens and thus ensuring pollination or alternatively, as has been observed in *T. hystrix*, the rolling of the petals may include the stamens and prevent self-pollination. There is also a possibility that allowing post-floral access time to the nectaries may encourage ant activity and thus discourage attack of the ovary by other boring insects.

### Dispersal unit

Despite some observations to the contrary (see under *T. suberosus* below), the fruits of all of the *Tribulus* species in Australia do eventually dissociate into fruitlets or cocci for dispersal. All species have the potential to produce 5 cocci from each fruit, but the actual number of cocci developing to maturity ranges from 1 to 5. Enclosed within the extremely hard cocci of the mature fruit are the seeds, which this author has found to be impossible to extract without damage.

Those species which have spines on the fruit clearly belong to the dispersal syndrome known as "trample burrs" (van der Pijl 1972). Thus species of *Tribulus* section *Terrestris*, together with *T. astrocarpus* and possibly *T. forrestii* are all prostrate and all have hard fruits lying upon the ground. Any pressure applied to these fruits from above will first of all cause dissociation of the cocci and, depending on the length of the spines and the hardness of the object applying pressure, may well result in penetration of the object applying the pressure. The subsequent dispersal will presumably depend on the effect that the penetrating spines have on the object. If the penetration causes irritation, it is likely that the dispersal will not be far, but in the case of an inanimate object such as a tyre or boot, the dispersal could be much further. It is interesting to note the record of 1911 (Dill & Bryan 1912) where an expedition to Laysan Island in the Hawaiian Group recorded a spiny *Tribulus* "seed" embedded in the sides of the toes of a Laysan albatross. This was identified as *T. hystrix*, which is certainly incorrect. It is more likely to have been the coastal species, *T. cistoides*. It is probably because of this dispersability that there is a problem with the taxonomy of section *Terrestris*.

On the other hand there is less of a problem with the taxonomy of the wing-fruited *Tribulus* species in Australia, and this may relate to the short distances over which they are dispersed. This group of species belonging to section *Alata* produce 5-winged fruits which at maturity, break into five 2-winged cocci. While workers in *Tribulus* (e.g. El Hadidi 1978) comment on the unusual (for *Tribulus*) upright shrub habit of *T. platypterus* and *T. suberosus*, dispersal of these winged cocci from a height would seem to be more efficient than dispersal from ground level, and it has to be asked what function a wing could have for a fruit which is already on the ground. The only time wings would seem to be advantageous in this situation would be if there were no competing vegetation and wind was a factor in the environment. *T. macrocarpus* is one such prostrate species producing winged fruits although the wings are much more thickened and not as wide as those in *T. platypterus*. It is found in mulga areas on red sand and under these conditions it is quite easy to envisage the circular fruit with its 5 wings as the primary dispersal agent. Subsequent dissociation of the fruit into its 2-winged cocci gives a secondary means of dispersal.

For a discussion of the particular dispersal characteristics of *T. suberosus* and *T. platypterus*, see under *T. suberosus* below.

### Scavengers of seed

In the mature fruit it is extremely difficult to remove seed from the hardened area of the coccus which surrounds it. *T. cichlerianus* is known to be a favoured food source of the Red-tailed Black Cockatoo (D. Albrecht, pers. comm. 1996), and it would not be surprising if *T. forrestii* and *T. macrocarpus* were also subject to attack in a similar fashion. In one specimen of *T. suberosus* at least (Eichler 23606 p.p.), the hardened area about the seed has been neatly opened and the seed removed, and it is presumed, because of the strength needed, that this was also done by a cockatoo.

Little evidence of insect attack was found on the mature fruits of *Tribulus*, but it would be surprising if there was not some interest shown by borers and/or weevils.

### Possible ant attractants

In *T. platypterus*, the area exposed when the fruitlets separate, particularly the area covering the seed, is covered with tiny gland-like excrescences which are here postulated to be food reward for ants. These glands are also to be found in *T. suberosus* but do not appear to be as numerous, and they have also, somewhat surprisingly, been seen in some members of the *T. terrestris* complex. The gland-like excrescences appear identical with those found on *Sida* L. (Malvaceae) cocci which are dispersed by

ants, but such glands appear never to have been investigated for an insight into the reward they might be offering. Given the size of the *T. suberosus* fruitlet, any movement by ants would have to be by the larger representatives of the community.

### Tentative key to *Tribulus* in Australia

It is unlikely that a vegetative key to *Tribulus* would be very satisfactory since there is overlap in most leaf characters, but the number of leaflets has been included as a subsidiary character for each of the species, along with the distribution. The key does rely on the presence of flowers or fruits. Relative style and stigma lengths are also important, but these can be judged from the flower or the fruit since the style and stigma invariably persist for some time and their relative lengths are unchanged.

- 1 Upright bushes. [Fruits winged, lacking any spines]
  - 2 Stems with corky bark. Sepals sparsely sericeous or patchily villous adaxially. Fruits tardily dissociating, densely pubescent between wings. [Hamersley Region, WA. Leaflet pairs (1)2-4(5)] ..... **2. *T. suberosus***
  - 2: Stems usually lacking corky bark. Sepals densely villous adaxially. Fruits quickly dissociating, sparsely pubescent between wings. [Hamersley Region, WA. Leaflet pairs (4)5-7] ..... **1. *T. platypterus***
- 1: Prostrate herbs
  - 3 Fruits star-shaped when viewed from above. [Mulga woodlands from Carnarvon to Warburton in WA, southern NT, northern SA and SW Qld. Leaflet pairs (3)4(5)] ..... **7. *T. astrocarpus***
  - 3: Fruits 5-lobed, or 5-winged, irregular or symmetrical, but not star-shaped
  - 4 Fruits winged, at maturity splitting into five 2-winged cocci
    - 5 Plants glabrescent. Fruits sparsely appressed pubescent, with a pair of median spines between the wings. [Cape Range to Geraldton and inland to southern NT and northern SA, usually in red sand. Leaflet pairs 5-7] ..... **5. *T. macrocarpus***
    - 5: Plants villous. Fruits densely pubescent between wings, lacking spines
      - 6 Fruits 20-32 mm high, 20-45 mm wide; wings lacking any hardening or spines, very inflated in fresh state. Style and stigma 3.5 mm long. [Hamersley region through to Rudall River and Great Sandy Desert in WA to southern NT. Leaflet pairs (3)5-6(8)] ..... **3. *T. hirsutus***
      - 6: Fruits 10-14 mm high, 18-25 mm wide; wings with hardened structures equivalent to spines just below middle in dried condition, in fresh state unknown. Style and stigma 1.8-2.3 mm long. [Mount Magnet, Newman, Leonora area, possibly extending through to Gibson Desert. Leaflet pairs (3)4-5(6)] ..... **4. *T. adelacanthus***
  - 4: Fruits not winged
    - 7 Plants subglabrous. Intrastaminal glands lacking. Fruits 5-lobed, glabrous or sparsely pubescent; cocci dorsally  $\pm$  smooth, reticulately marked, rounded and with a pair of median spines. [Carnarvon/Shark Bay area of WA. Leaflet pairs 6-7] ..... **6. *T. forrestii***

- 7: Plants villous. Intrastaminal glands present. Fruits irregular or 5-lobed, sparsely to densely pubescent; cocci dorsally spiny or tuberculate, rarely rounded, usually with more than median pair of dorsal spines
- 8 Fruits with many spines distributed randomly all over; cocci not bilaterally symmetrical
- 9 Fruits with spines 10-17 mm long; petals 15-30 mm long. Style 4-5 mm long. [Fruits up to 30 mm high and 50 mm wide. Red sand dunes of central interior of Australia. Leaflet pairs (4)7-9] ..... **9. *T. hystrix***
- 9: Fruits with spines less than 8 mm long. Petals 6-17 mm long. Style less than 2 mm long
- 10 Flowers with petals 10-17 mm long. Fruit 10-20 mm high, 20-30 mm wide, spines 4-6(8) mm long. [Coastal areas of WA from Broome to Carnarvon. Leaflet pairs 7-10] ..... **8. *T. occidentalis***
- 10: Flowers with petals 6-7 mm long. Fruit 7-10 mm high, 12-15 mm wide, spines 0.5-4 mm long. [Saline soils on edges of salt pans, central Australia. Leaflet pairs 6-7] ..... **10. *T. sp. saline flats***
- 8: Fruits sometimes tuberculate and often with a pair of median and basal spines, but lacking spines distributed all over; cocci bilaterally symmetrical
- 11 Flowers with petals more than 15 mm long. [Stigma shorter than style]
- 12 Style 4 mm long or more; petals 15-35 mm long. Leaves with 8-10 pairs of leaflets; leaflets less than 2.5 mm wide. [Kununurra and Victoria River area. Leaflet pairs 8-10] ..... **11. *T. ranunculiflorus***
- 12: Style less than 4 mm long; petals 15-18 mm long. Leaves with 5-8 pairs of leaflets; leaflets 3-5 mm wide
- 13 Fruit pubescent with relatively dense short hairs overtopped by sparser long strigose hairs; median pair of spines present or absent. [Tanami in NT to Rudall River, Giles and Hamersley region in WA. Leaflet pairs 6-8] ..... **14. *T. sp. long-styled eichlerianus***
- 13: Fruit subglabrous, very sparsely strigose; median pair of spines always present. [Coastal sands of tropical Australia. Leaflet pairs 5-7] ..... **12. *T. cistoides***
- 11: Flowers with petals less than 15 mm long
- 14 Fruits 7-13 mm high, 10-20 mm wide, densely pubescent all over. Intrastaminal glands forming a ring. [Stigma 1.3-2.5 mm long, longer than style. Drier areas of all states except Victoria and Tasmania. Leaflet pairs 6-10] ..... **13. *T. eichlerianus***
- 14: Fruits 4-7.5 mm high, 5-13 mm wide, subglabrous to moderately pubescent only. Intrastaminal glands 5, distinct [*T. terrestris* complex]
- 15 Cocci with distinct divergent, median spines 3-8 mm long
- 16 Style 0-0.3 mm long, shorter than stigma. [Southern Australia in waste places, also about Broome, WA. Leaflet pairs 4-7] ..... **15a. *T. terrestris* (short style)**
- 16: Style 0.6-1.4 mm long, longer than or equal to stigma. [Northern Australia in waste places. Leaflet pairs 4-7] ..... **15b. *T. terrestris* (long style)**

- 15: Coci either lacking median spines or these less than 3 mm long
- 17 Style 0.2-0.7 mm long, shorter than or equal to stigma. Petals 2.5-7 mm long. Fruits 5-7.5 mm high. [Mostly southern Australia, with larger fruited specimens through to Alice Springs area. Leaflet pairs 5-7] ..... 16. *T. minutus*
- 17: Style 0.7-1.4 mm long, longer than or equal to stigma. Petals 5-15 mm long. Fruits 4-5 mm high. [Central Australia & Qld. Leaflet pairs 4-7] ..... 17. *T. micrococcus*

### Endemic Australian species not included in Section *Terrestris* Hadidi

1. *Tribulus platypterus* Benth., Fl. Austral. 1: 289 (1863). *Type*: For citation of types see Barker (1996).

*Distinguishing features.* Distinguished from all other *Tribulus* species except *T. suberosus* by its shrubby habit. *T. platypterus* differs from *T. suberosus* by the lack of development of corkiness on the stems, by its fruits more or less glabrous between the wings, by its longer styles (4-6.5 mm long) and by the higher number of leaflet pairs on a mature leaf (5-7).

*Notes.* The record of this species for the Kimberley region by Lawrence (1992) is erroneous. The cited collection from 17 miles north of Christmas Creek on the Rabbit Proof Fence represents the Christmas Creek just north of Roy Hill and not the Christmas Creek in the southern Kimberley. Thus *T. platypterus* occurs from the Hamersley Pilbara region across to Rudall River in Western Australia. It does not extend as far south as *T. suberosus*.

2. *Tribulus suberosus* H. Eichler ex R.M. Barker, *sp. nov.*

*Tribulus suberosus* H. Eichler ex R.M. Barker, J. Adelaide Bot. Gard. 17: 171 (1996) *nom. inval.*, type not cited.

*Typus*: At the base of Mt Bruce, Hamersley Range National Park, Western Australia, 1 May 1977, H. Eichler 22569 (*holo*: CANB 255582; *iso*: PERTH 04182464, NSW).

*Specimens examined.* WESTERN AUSTRALIA: Opposite Fortescue roadhouse, 30 Aug. 1985, H. Eichler 23606 (CANB, MEL, NSW, PERTH - mixture of *T. platypterus* and *T. suberosus*); Karratha, Sep. 1982, P. Glennon 64B (PERTH).

*Distinguishing features.* Distinguished from all other *Tribulus* species except *T. platypterus* by its shrubby habit. *T. suberosus* differs from *T. platypterus* by the development of corkiness on the stems, by its fruits with dense pubescence between the wings, by its shorter styles (2-4 mm long) and by the lower number of leaflet pairs on a mature leaf (2-4).

*Comments on the type collection.* The type collection displays the very characteristic corky stems of the species, although it should be noted that occasional *T. platypterus* specimens also develop some corkiness (c.g. Eichler 23606). A number of fruits are also present on the holotype and these display another characteristic of the species which distinguish it from *T. platypterus*, viz. the dense pubescence to be found in the area between the wings. No flowers are present.

*Notes.* The name *T. suberosus* H. Eichler ex R.M. Barker, published by the author (Barker 1996), was invalid since the type was inadvertently omitted. The name is validated here by the citation of the type with reference to the previously published description and diagnosis (Article 32.3, International Code of Botanical Nomenclature, Greuter 1994). As well as the description and Latin diagnosis, all other details of distribution, ecology, synonymy and specimens examined are to be found in the earlier publication.

Dispersal of *T. suberosus* and its close relative, *T. platypterus*, has not been documented but the following observations have been made. It has been reported that the larger fruit of *T. suberosus* does not break as easily into its five 2-winged components as does that of *T. platypterus*. This comment was provided by Mrs P. Glennon who noted on her collection (Glennon 64B) of *T. platypterus*, that "fruits separate easily when ripe unlike inland wood ones [?] *T. suberosus* which are large and adhere." Mrs Glennon further credits Jack Paine, the last government nurseryman [in Karratha], as noting that the inland variety which is presumably attributable to *T. suberosus* as above "germinates best if no attempt is made to separate carpels". My own field observations do not support this. While *T. suberosus* fruits may be tardier to break up than those of *T. platypterus*, since at the green stage they show no inclination to split apart and this continues even when the fruits are dried, they do break up quite easily (on touch) provided the fruit is ripe and yellowish in colour. The dispersal unit in both species is the 2-winged fruitlet.

**3. *Tribulus hirsutus* Benth., Fl. Austral. 1: 289 (1863).** *Type citation:* Nich[k]ol Bay, F. Gregory. *Type:* Nickol Bay [Western Australia], s.dat. [1861], P. Walcott s.n. (*lecto*, here designated: MEL 79405); Nickol Bay [Western Australia], Gregory's Expedition, s.dat., Herb. Mueller s.n., (*isolecto*: K-herb. Hooker).

*Tribulus alatus* auct. non Delile: F. Muell., Trans. Bot. Soc. Edinburgh 7: 487 (1863).

*Distribution.* Found in the Pilbara region of Western Australia through to the Rudall River area and Great Sandy Desert to southern Northern Territory.

*Distinguishing features.* In fresh material the fruits are deeply 5-lobed, soft-textured and without any spines. Other species, such as *T. forrestii*, *T. macrocarpus* and some of the *T. terrestris* group could be described as 5-lobed but they all have a much more leathery texture and have median spines. At maturity, in dried specimens, the wings of the fruit are usually much larger in *T. hirsutus* than any other species in Australia, although there are a few specimens where the wings are similar in size to those of *T. platypterus* and *T. suberosus*. However these latter species are shrubs, while *T. hirsutus* is prostrate.

*Typification.* The MEL sheet indicates that the collector of this species was Pemberton Walcott, a volunteer member of Francis Gregory's 1861 expedition to the Hamersley region (Birman 1979). The sheet in K does not indicate the collector but merely that it was the result of Gregory's Expedition. Mueller has annotated the MEL sheet as "*T. alatus*?" and just below this Bentham has annotated it as *Tribulus hirsutus*. Both collections are scrappy but there is more material on the MEL sheet and so it has been selected as the lectotype.

Bentham's erroneous protologue description of the species as "a shrub allied to *T. platypterus*" was presumably based on the resemblance of the fruit of *T. hirsutus* in the dried state to that of the shrubby species *T. platypterus* of the same region. There are no notes on habit with the specimen and it is impossible to determine that it is prostrate from the scrappy fragments which make up the type sheets.

*Notes.* This is a variable species with respect to leaflet size and pubescence. The fruits of this species are markedly different in their fresh state to those encountered on the herbarium sheet or in the dried

state. Before drying out, the walls of the five carpels are quite inflated and with brown or red coloration, resembling more the shape of the fruit in *T. forrestii*. On drying, the lateral walls collapse in on each other and then split to form the two wings of each fruitlet. The dispersal unit is the two-winged fruitlet as in *T. macrocarpus*, *T. suberosus* and *T. platypterus*, but it is almost certainly derived in a different fashion, since these latter species are clearly 5-winged from their earliest formation.

#### 4. *Tribulus adelacanthus* R.M. Barker, *sp. nov.*

Species nova *T. macrocarpo* proxima sed differt densibus pubescentibus fructibus et destitutis paribus spinarum inter alas.

*Typus:* c. 22 miles [35 km] south of Wongawol Station Homestead, Western Australia, 28 July 1963, A.S. George 5588. Prostrate ephemeral herb; fruits orange-brown. (*holo:* PERTH 03776166; *iso:* CANB 359689).

Prostrate *herb*, stems at least 20 cm long. *Leaves* in unequal pairs or, more usually alternate, with (3)4-5(6) pairs of leaflets above 4-11 mm long petiole; leaflets elliptic or ovate, sometimes narrowly so, shortly petiolulate, rounded-oblique, shortly acuminate,  $\pm$  concolorous, glabrous or sparsely white villous adaxially, denser abaxially, 5.5-11 mm long, 3-4.5 mm wide. *Fruiting pedicel* 9.5-14 mm long. *Sepals* mostly unknown, but villous externally. *Flowers* unknown. *Ovary* densely white pubescent, 5-celled; style and stigma 1.8-2.3 mm long in fruit, stigma 0.5-1.0 mm long. *Fruit* star-shaped with apical conical projection, 10-14 mm high, 18-25 mm wide, 5-winged by wings from apex of conical projection to the ends of each of the arms and then to the apex of the pedicel, densely pubescent all over with a mixture of simple, bent, shorter, softer hairs and longer, more robust hairs, lacking external spines, probably dissociating into five 2-winged cocci.

*Specimens examined with typical features.* WESTERN AUSTRALIA: 10 km from Mount Magnet on Geraldton Road, 9 Mar. 1963, Y. Chadwick 1979 (PERTH); Leonora district, July 1963, S.B. Dimer per A.C. Linto s.n. (PERTH); Bulloo Downs Station, 3 Oct. 1978, A.A. Mitchell 640 (PERTH); Ashburton, Sep. 1971, M. Wittwer S1775 (PERTH).

*Specimens examined with affinities to T. macrocarpus.* WESTERN AUSTRALIA: Eagle Bore Study area, Gibson Desert Nature Reserve, burnt site 3 km N of camp, 2 Sep. 1991, A. Chapman & S. Fraser 89 (PERTH); Young Range, Gibson Desert, Sep. 1992, *Desert Dreaming Expedition* 9 (PERTH); Exburn, N of Camp Zone 3, Gibson Desert Eagle Camp, Sep. 1992, *Desert Dreaming Expedition* 144 (PERTH).

*Distribution.* Known only by four collections in Western Australia, one from Bulloo Downs, south of Newman, one from the Mount Magnet area, one from the Leonora district and one from the Wongawol area near Lake Carnegie. Specimens from the Gibson Desert may also belong here. Ecology and flowering time of the species is unknown.

*Etymology.* The specific epithet comes from *adelos*, Greek for unseen or obscure and *acantha*, Greek for spine or thorn, in reference to the spines which in this species are apparently hidden within the wings.

*Distinguishing features.* As with most *Tribulus* species it is the fruit shape which is diagnostic for *T. adelacanthus*. As stated below the fruits appear to be based on the same framework as the fruit of *T. astrocarpus* but with an added wing from the apex to each of the legs and then to the apex of the pedicel. The fruits are densely pubescent all over.

*Notes.* *Tribulus adelacanthus* is described from limited material. The author would appreciate further collections so that its variability and relationships can be properly investigated and its description completed.

It has sometimes been confused with *T. hirsutus* in the past although Lawrence (on PERTH specimens) suggested that it was "intermediate between *Tribulus* sp. B [*T. ?suberosus*] and *T. hirsutus*". *T. hirsutus* has very inflated cocci in its fresh state and there is no underlying hardened framework within the walls of these cocci, as there is in *T. adelacanthus*.

Based on the fruit alone, *T. adelacanthus* seems to be closely related to *T. macrocarpus* and *T. astrocarpus*. The spines usually present between the wings of *T. macrocarpus* appear to have become longer and amalgamated with the wing. Another way of viewing the fruit is as a *T. astrocarpus* fruit with wings from the apex to the end of each of the five spines, these wings then continuing from the spines to the pedicel apex and base of the fruit.

The presence of spines within the wing is not unknown since material of *Tribulus cristatus* from South Africa, seen in AD, has numerous spines projecting from the ends of its wings.

*T. macrocarpus* and *T. adelacanthus* can be distinguished by the subglabrous fruits with only a sparse appressed pubescence and external spines between the wings for *T. macrocarpus* compared with the pubescent fruits and internal spines of the new species. There may also be a distinct difference in the lengths of the style and stigma between the two taxa, with those of *T. macrocarpus* being longer, but there is insufficient flowering material of the new taxon to be sure about this. The new taxon may also have a more southerly and inland distribution than *T. macrocarpus*.

The Gibson Desert collections have the spines more or less amalgamated with the wing but the fruits are not as densely pubescent as those of collections from further south. They also appear to have the shorter styles and stigmas associated with the new taxon, but the lengths also apply to *T. macrocarpus* with which these collections also have affinities.

**5. *Tribulus macrocarpus*** F. Muell. ex Benth., Fl. Austral. 1: 289 (1863). *Type citation*: N. Australia. In the interior, from Nichol Bay, *F. Gregory*. *Type*: Nichol Bay [Western Australia], *s.dat.*, *Anon.* [Unknown. Brought in from interior by Party] (probable *holo*: MEL 79423).

*Tribulus* sp. F. Muell., Trans. Bot. Soc. Edinburgh 7: 487 (1863).

*Specimens examined.* WESTERN AUSTRALIA: 125 km S of Barradale, *Hj. Eichler* 23611B (CANB, PERTH); c. 0.5 km N of No. 18 Bore, Hamelin Station, *Hj. Eichler* 23646 (CANB); Cape Range, *Grealley* 10 (PERTH).

NORTHERN TERRITORY: South Lake Hopkins, *P.K. Latz* 7998 (CANB, DNA).

*Distribution and ecology.* Found in dry areas of Western Australia, from Cape Range to Geraldton and inland to southern Northern Territory, and north of Oodnadatta in South Australia. Found in red sand, usually in mulga with *Aristida*, *Plectrachne* or *Triodia*, sometimes the sand over limestone.

*Phenology.* Flowering predominantly April through to September, occasionally also outside these months.



*Distinguishing features.* Fruits in this species resemble small balls with 5 narrow longitudinal wings. Between the wings there are usually two median downward pointing spines, although these are not always obvious.

*Typification.* The type in MEL consists merely of 13 dissociated cocci with quite narrow wings. There is nothing on the labels to indicate that the collector was Gregory, indeed it is unlikely that it was him since it was brought in by the “Party”. The material is annotated with the name by Mueller and has been seen by Bentham. In the same year as the protologue Mueller mentioned this species in an account of the specimens collected on the Gregory expedition (Mueller 1863) but did not use the epithet he had coined.

*Notes.* A single specimen from the Cape Range (*Grealy* 10) has much larger flowers and a longer style and stigma than is usually found in this species. Whether this is of any taxonomic significance is unknown since there is only the one collection from the area, but the Cape Range is known to support plants which show divergence from the rest of their species or are in fact different taxa e.g. *Calophanoides* (Acanthaceae), *Abutilon* (Malvaceae), *Stackhousia* (Stackhousiaceae).

**6. *Tribulus forrestii*** F. Muell., Southern Science Record 1 (New Series) (Nov. 1885), apparently distributed only as page proofs to Kew and Germany, but also published by Mueller in Bot. Centralbl. 24: 373 (1885). *Type citation:* Near the Gascoyne-River, Hon. J. Forrest; also sent from thence by Mr. Jones, but as yet only fruiting specimens obtained. *Type:* Gascoyne River [Western Australia], 1880, *Jones s.n.* (*lecto*, here designated: MEL 79403); Gascoyne River [Western Australia], 1882, *J. Forrest s.n.* (*syn:* MEL 79404).

*Distribution and ecology.* *T. forrestii* is confined to the Carnarvon area of Western Australia, particularly in the Shark Bay area. It is recorded from sand, calcareous clay, red-brown clay and red sandy clay, usually from within shrubland, but sometimes from disturbed areas.

*Phenology.* Flowering between April and September.

*Distinguishing features.* Fruits in *T. forrestii* are circular, 5-lobed and regular (except when not all carpels develop) with a smooth, reticulately marked surface (similar to the shell of a peanut) and a pair of median dorsal spines on each of the developed cocci.

*Typification.* The Jones material is the more copious and has a number of mature fruits whereas the Forrest material has only immature fruits present. Mueller has annotated both sheets but the Jones specimen has further notes on the shape of the fruit in comparison with that of *T. macrocarpus*. For this reason it has been selected as the lectotype of *T. forrestii*. Despite his statement to the contrary, Mueller did have flowering material available to him in the form of earlier collections by Forrest and Carey in 1878, but neither of these had fruits and so he did not recognize them as *T. forrestii*. It is not entirely clear where *T. forrestii* was first published. The particular issue of Southern Science Record was apparently never published and the paper containing the description of *T. forrestii* only ever distributed as an Extra Print to Kew and Germany (see Churchill *et al.* 1978). However, Article 29 of the International Code of Botanical Nomenclature (Greuter *et al.* 1994) states that publication is effected by “distribution of printed matter (through sale, exchange, or gift)....to botanical institutions with libraries accessible to botanists generally” and so these conditions would seem to have been met by the distribution to Kew Gardens. Mueller did publish the same name in the same year in Bot. Centralbl. and so it is only the place of publication which might be questioned.

**7. *Tribulus astrocarpus*** F. Muell., *Fragmenta Phytographiae Australiae* 12: 4 (1882). *Type citation*: Prope flumen Gascoyne River; J. Forrest. *Type*: Menilyalya River north of Shark Bay [Western Australia], 1882, *J. Forrest s.n. (lecto*, here designated: MEL 79395); Gascoyne River [Western Australia], 1882, *J. Forrest s.n. (isolecto*: K).

*Representative specimens examined*. WESTERN AUSTRALIA: Great Northern Hwy, 45.6 km S of Kumarina, 27 Aug. 1995, *R.M. Barker* 1067 (AD); No 1 Well, Canning Stock Route, *L.A. Craven* 5044 (CANB, PERTH); Warburton Community, between shop and river bed, *F.A. Zich* 76 (CANB, NSW, PERTH, PRE).

NORTHERN TERRITORY: Plenty Highway, 22 km NE of Stuart Highway, *K.L. Wilson* 4641 (DNA, NSW). SOUTH AUSTRALIA: Timber Camp Bore, Hamilton Station, 100 km N of Oodnadatta, *F. Badman* 309 (AD, BRI, C, CANB, MEL, NSW).

QUEENSLAND: 72 km S of Winton, Mar. 1971, *P. Knowles s.n.* (BRI).

*Distribution and ecology*. Occurs in Western Australia from Carnarvon to Warburton, extending into southern Northern Territory, south-west Queensland and northern South Australia, invariably within mulga woodland. Soils vary from red sand to pebbly brown clay.

*Phenology*. Flowering has been recorded in most months of the year but predominantly March to May and August to September.

*Distinguishing features*. The star-shaped fruits of this species are very distinctive.

*Typification*. Both sheets have been annotated by Mueller as "*Tribulus astrocarpus*", although the lectotype is annotated as "*asterocarpus*" with the "e" crossed out. The MEL sheet consists of three fragments and contains flowers and young and mature fruits. In contrast, the sheet in K has only a single fragment with one mature fruit present. Both specimens were seen as photographs in the Eichler manuscripts.

*Notes*. There seem to be two flower sizes amongst the material studied. The few specimens with larger flowers, i.e. petals up to 10 mm long (e.g. *Knowles s.n.*, *Craven* 5044), were more robust plants and tended to be flowering in the earlier months, but there does not appear to be any pattern to their distribution since they came from all states except South Australia. These larger flowers tend to have at least 2 or 3 stamens with longer anthers; these are possibly staminodal. Also associated with the larger flower size, as might be expected, was a longer style.

### Section *Terrestris* Hadidi, *Taeckholmia* 9: 60 (1978)

The taxonomy of this whole group is very unsatisfactory and much in need of world-wide revision. Many specimens exist which possess characteristics of more than one species and there is an urgent need, particularly in view of efforts to find a biological control for *T. terrestris*, of an understanding of the biology of the whole group before a satisfactory classification can be achieved. It is likely that some of these species are much more closely related than the present taxonomy suggests, and it is also likely that barriers to crosses between species are not well developed. Even some basic experimental work to establish whether such crosses are possible and the characteristics of any progeny may help to place the taxonomy on a firmer footing.

**8. *Tribulus occidentalis*** R. Br. in Sturt, Expedition into Central Australia 2 App. 69 (1849). *Type*: For a discussion of the typification of this species see Wilson (1992a).

*Representative specimens examined.* WESTERN AUSTRALIA: Karratha Beach, on first sand dune back from beach, next to road, R.M. Barker 1145 (AD, dupl. to be distributed); Dampier, at Dampier Clinic (Marine Biological Station), H.J. Eichler 23602 (CANB, NSW, PERTH); Point Sampson, 28 Mar. 1921, C.A. Gardner 1634 (PERTH); 116 km S of Barradale, Carnarvon Road, 8 June 1988, S. Jacobs 5846 & P. Wilson (NSW); c. 14 km SE of Carnarvon along the NW Coastal Hwy, P.S. Short 1574 (CANB, MEL); Beside road near parking area at lagoon 1 km from Port Smith camping area, Port Smith, F. Zich 155 (CANB, DNA, NSW, PERTH, PRE, US).

*Specimens examined showing some approach to *T. hystrix*.* WESTERN AUSTRALIA: 35 miles [56 km] N of Winning Station, D.E. Symon 5424 (AD, CANB, PERTH); 64 miles [102 km] S of Onslow, H. van Dam 136 (AD, 2 sheets).

*Distribution.* Confined to the west coast of Western Australia from Broome to Carnarvon.

*Phenology.* Flowering April to September.

*Distinguishing features.* When fruits are present, *T. occidentalis* is easily distinguished by the presence of spines all over the fruit. Spines are shorter than those found in *T. hystrix* (up to 8 mm long compared with up to 17 mm long in *T. hystrix*). Flowers are large (petals 10–17 mm long) but the style and stigma are more or less equal in length and 1–2 mm long.

*Notes.* *T. occidentalis* is usually distinguishable from *T. hystrix* by the smaller fruits and flowers and by the style and stigma of similar length. The nectary glands in *T. hystrix* appear to form a complete ring whereas in *T. occidentalis* they are distinct from each other. Some specimens of *T. occidentalis* which approach *T. hystrix* are listed above and discussed in the notes under *T. hystrix*.

*T. occidentalis* occupies a similar coastal locality to *T. cistoides*, although also occurring further inland, and without fruits these two are difficult, if not impossible, to distinguish. When fruits are present, *T. cistoides* has only 2 pairs of spines, one median and one basal, compared with the all over distribution of spines, some of which may be branched, in *T. occidentalis*. See notes under *T. cistoides*.

A specimen from Barradale (Jacobs 5846) in Western Australia has the flower size (petals c. 12 mm long) and developing fruits of *T. occidentalis*, but the style (c. 1.6 mm) is longer than the stigma (c. 1 mm), whereas it is usual for the stigma to be longer than the style in this species.

Bentham (1863) treated *T. occidentalis* as a synonym of *T. hystrix* apparently based on the diagnosis only since he was unable to locate the specimens seen by Robert Brown. Mueller (in Mueller & Tate 1896) claimed that it was he who was responsible for making this decision in his account of the plants of the Babbage Expedition. If it was Mueller who first suggested this, then it was not in this account of the Babbage collection (Mueller 1859), since *T. occidentalis* is not mentioned there. However, it may have been the account of the Gregory Expedition that Mueller meant, since he certainly treated plants collected by Walcott and Brown as *T. hystrix* (Mueller 1863). Bailey (1899) possibly confused the situation even further by choosing to call the only specimen of *T. hystrix* that he saw from the Diamantina in Queensland (*Bancroft s.n.* in BRI), *T. occidentalis*.

**9. *Tribulus hystrix*** R. Br. in Sturt, Expedition into Central Australia 2 App. 69 (Jan.-Feb. 1849). *Type citation*: in collinis arenosis. Lat 26°, D. Sturt. *Type*: Sand Hills in Lat about 26°, *s.dat.*, *Captain Sturt* 109 (*holo*: BM *n.v.*, seen as photograph in Eichler manuscripts).

*Representative specimens examined*. NORTHERN TERRITORY: Camel Lake, Simpson Desert, D.F. Gibson 61 (DNA).

SOUTH AUSTRALIA: Priscilla Creek, 30 km NW of Finnis Creek on Oodnadatta road, K.L. Wilson 4601 & R.M. Barker (AD, CANB, NSW); 5 km N of Stuart Creek Homestead, F.J. Badman 1587 (AD, HO, MEL).

QUEENSLAND: c. 27 km SW of Betoota, K.P. Nicolson 291 & P.E. Novelty (BRI).

*Distribution*. Found in northern South Australia, south eastern Northern Territory and south west Queensland. It has been recorded from Western Australia in the past (Hnatiuk 1990) and is in the WAHERB Census, but most of the material identified as such is probably *T. occidentalis* (but see notes below).

*Distinguishing features*. If fruits are present, this species cannot be confused with any other *Tribulus* species in Australia. Their size (up to 30 mm high and 50 mm wide) far exceeds that of any other species, and the length of the narrow spines (10-17 mm) is also diagnostic. In the absence of fruits, the large size of the flowers and length of the style (4-5 mm), coupled with a known distribution, should be sufficient to identify *T. hystrix*.

*Typification*. The holotype sheet consists of a single branch with a flower and a single fruit. It has been annotated by Brown as "*Tribulus hystrix* Br."

*Notes*. Mueller annotated a number of specimens of *T. hystrix* as "var. *grandiflorus*" including that of McDouall Stuart's from Attack Creek (MEL 79414) which was seen by Bentham, but the name has never been published.

*T. hystrix* can be distinguished from *T. occidentalis* by the much longer style than stigma, by the larger flowers and fruits and possibly by the intrastaminal gland being a complete ring rather than 5 distinct lobes. Distribution also often helps in distinguishing the two species, with *T. hystrix* coming from central Australia and *T. occidentalis* from the west coast of Western Australia between Broome and Carnarvon. However, there are some specimens from the west coast of Western Australia and the intervening area which appear to break down the distinctions by approaching *T. hystrix* in some characters rather than *T. occidentalis*, raising the possibility that the two species are merely ends of a cline. The intervening specimens tend to have larger flowers than is usual for *T. occidentalis* (petals up to 28 mm long) and the styles are longer than the stigmas, but not as long as the 4-5 mm found in *T. hystrix*. Spines on the Symon collection are less than 8 mm long, which is characteristic of *T. occidentalis*. The disc may be a continuous ring rather than distinct glands but this character is not always reliable or easy to interpret. Bentham treated *T. occidentalis* as a variety of *T. hystrix* and his concept may eventually prove to reflect the relationship better than the maintenance of the two as species. However, complete specimens are needed of both species as well as more specimens from the area between their present known distributions, before a decision can be made on their taxonomic status.

# **10. *Tribulus* sp. *saline flats* (P.K. Latz 4530)**

?*Tribulus occidentalis* (smaller flowers and fruits) K.L. Wilson, *Telopea* 5(1): 28(1992).

Prostrate, villous *herb*, stems up to 30 cm long. *Leaves* in unequal pairs, more rarely alternate, with 6-7 pairs of leaflets above 1-5 mm long petiole; leaflets narrowly elliptic, shortly petiolulate, base oblique, acute, discolorous, villous adaxially, more densely villous abaxially, 4-6.5 mm long, 1.5-2.5 mm wide. *Flowering pedicel* 5-8 mm long, upright, fruiting pedicel 10-16 mm long. *Sepals* c. 4 mm long, glabrous adaxially except for apical pubescence and densely villous abaxially except on hyaline margin. *Petals* yellow, obovate, glabrous, c. 6-7 mm long, longer than sepals. *Intrastaminal glands* 5. *Stamens* 10, at maturity equal to stigma; filaments c. 2 mm long; anthers 1.2 mm long. *Ovary* densely white pubescent, 5-celled; style 0.5-1 mm long in flower; stigma 0.9 mm long. *Fruit* 7-10 mm high, 12-15 mm wide, dissociating into 3-5 asymmetrical, moderately pubescent, woody cocci, with more or less equal, 0.5-4 mm long, spines all over dorsal surface.

*Specimens examined.* WESTERN AUSTRALIA: 2.7 km along Point Quobba Road from NW Coastal Hwy, 6 Sep. 1995, R.M. Barker 1209 (AD, dupl. to be distributed); Cavanagh Range, 7 July 1963, A.S. George 4780 (CANB, PERTH).

NORTHERN TERRITORY: Newhaven Station, P.K. Latz 2172 or 2127 (AD, CANB, DNA, PERTH); 2 miles [3.2 km] W Quartz Blow Rockhole, N. Henry 402 (CANB, DNA); 14 miles [23 km] S Rabbit Flat, P.K. Latz 4530 (DNA, PERTH).

NEW SOUTH WALES: Salisbury Downs Station, P. Martensz 2758 (CANB).

*Distribution and ecology.* Occurs in Northern Territory and Western Australia, with an outlier in New South Wales. Usually recorded as being found in sandy saline soils or on the edges of salt pans, but there are other records of it from sandy soil over limestone, or merely from a sandhill (Martensz 2758).

*Phenology.* Flowering January to May, presumably in response to rains.

*Distinguishing features.* This taxon possesses the small flower size and style and stigma lengths of *T. eichlerianus*, but the fruits are more like miniature *T. hystrix* fruits.

*Notes.* Occasional specimens (e.g. Dunlop 2107) bearing fruits similar to those of this species have been found with the much larger flowers and longer styles of *T. sp. long-styled eichlerianus* or *T. cistoides* (see notes under that taxon).

The Martensz collection agrees with this material in all respects except that its distribution is considerably removed from the rest of the collections and it is recorded as coming from a sandhill. Similarly the Barker collection from the west coast of Western Australia is also considerably removed from the other collections listed, although it was made from a red sand area adjacent to a salt lake. Such a widely disjunct distribution, even though it may merely reflect inadequate collecting, casts some doubt on the validity of this taxon, and is another reason why it has not been formalized here.

**11. *Tribulus ranunculiflorus*** F. Muell. (possibly *nom. nud.*) in Hooker's Journal of Botany & Kew Garden Miscellany 8: 323 (1856); F. Muell., Fragm. 1: 48 (1858). - *Kallstroemia ranunculiflora* (F. Muell.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. 3(4): 88 (Dec. 1890). *Type*: Upper Victoria River, Northern Territory, January 1856, F. Mueller s.n. (*syn*: MEL 79472); Wickham's Creek, Northern Territory, April 1856, F. Mueller s.n. (*syn*: K).

*Tribulus* sp. A, Lawrence, Fl. Kimberley Region 681, f. 210F (1992).

*Specimens examined.* WESTERN AUSTRALIA: main road opposite gate of Kimberley Experimental Farm, Dept of Agriculture, Kununurra, 11 Mar. 1978, T.E.H. Aplin 6301 (CANB, PERTH); Kununurra,

29 Feb. 1972, *D. Bedbrook* 10B (PERTH); Kununurra area, *T.F. Black* 10 (PERTH); bitumen road verge, black clays near OPRS, Jan. 1981, *C. Glover* 1-7 (PERTH); opposite Kununurra airport, *E.C. Glover* 56 (PERTH); Kimberley Research Station, Ord Sandy Loam, *E. Langfield* 58 (PERTH); ?9 km N of Kununurra at Mocks Dairy on E side of Ivanhoe Crossing road adjacent to milking parlour, 6 May 1993, *A.A. Mitchell* 3085 (BROOME, NSW n.v., PERTH); Airport entrance, Kununurra, *R.W. Purdie* 3303 (DNA); Kununurra, street edges near swimming area, 4 June 1975, *D.E. Symon* 10331 (AD, CANB, K, PERTH).

*Specimen examined with affinities to T. ranunculiflorus.* WESTERN AUSTRALIA: Mackay Creek, 31 July 1977, *Anon.s.n.* (PERTH 03776085).

*Distribution.* Apart from the type, known only from the Kununurra region of Western Australia.

*Distinguishing features.* This species has the large flowers of *T. hystrix*, but does not develop the extremely large spiny fruit of that species; instead it has fruits more like those of *T. terrestris*, with only a median and basal pair of spines. Mature leaves have 8-10 pairs of leaflets, with these leaflets being narrowly elliptic and no more than 2.5 mm wide. The style is 4-7 mm long, considerably longer than the stigma, and longer than any other of the sect. *Tribulus* species in Australia, apart from *T. hystrix* (which has a style length of 4-5 mm).

*Typification.* Both syntype collections have been labelled as *Tribulus ranunculiflorus* by Mueller, but both have petals c. 15 mm long and styles 4-5 mm long i.e. at the lower end of the range of measurements for this taxon. However, in the crucial measurements of petal and style length, the protologue gives a length of "7-10 lin." [15-22.5 mm] for the petals and "3-4 lineas" [6.75-9 mm] for the style. These petal measurements place the types with the taxon recognized here, but the style length is longer than that recorded for any specimens (see Table 2). Both types have only been seen as photographs in the Eichler collection of protologues and need to be checked further before a decision as to the application of the name *T. ranunculiflorus* to this taxon is made.

*Notes.* Since the type collection of *T. ranunculiflorus* has petals c. 15 mm long and a style length of c. 4.5 mm it was initially thought that *T. ranunculiflorus* might prove to be synonymous with *T. cistoides*. This was reinforced by a further three collections from Kununurra (*Langfield*, *Purdie* and *Symon*, referred to as small-flowered in Table 2) apparently sharing these attributes. However, other collections (*Aplin*, *Black*, *Glover* and *Mitchell*) from Kununurra have flowers with longer petals and styles, making them very distinct from any other species in Australia. A comparison of these entities is given in Table 2 and from that it can be seen that all of the specimens separated as *T. ranunculiflorus*, despite their variation, can be distinguished from *T. cistoides* by their style length, their leaflet number, their leaflet width and their fruit width. Fruits of *T. cistoides* are similar to those of *T. terrestris* in shape but much more robust; fruits of *T. ranunculiflorus* bear a remarkable resemblance to those of *T. terrestris* except for the presence of the very long style. *T. terrestris* and *T. ranunculiflorus* do apparently occur together since the collections *Mitchell* 3085 and 3086 are both given the same locality details.

El Hadidi has annotated a duplicate of the Symon collection in K as *T. zeyheri* Sond., another species which is only doubtfully distinct from *T. cistoides*, but this is clearly erroneous since *T. zeyheri* lacks an elongated style (see under *T. cistoides* notes below).

Differences in flower size probably relate to soil type since the larger-flowered specimens of *T. ranunculiflorus* are all recorded as coming from black clay areas while the smaller-flowered specimens are from sand and loams.

Table 2. Comparison of the type specimens of *T. ranunculiflorus* with small-flowered Kununurra specimens of *T. ranunculiflorus*, all *T. ranunculiflorus* and *T. cistoides*.

Characters	<i>Tribulus ranunculiflorus</i>			<i>T. cistoides</i>
	all specimens	type specimens	small-flowered specimens	all specimens
petal length (mm)	(15)25-35	c. 15	15-20	15-16
style length (mm)	4-7	c. 4.5	4	1.8-3
stigma length (mm)	0.5-0.7	—	0.5	0.3-1.5
leaflet number	8-10	8-10	8-10	5-7(8)
leaflet width (mm)	1-3	c. 2	1-3	3-5
fruit width (mm)	up to 10	-	-	up to 15

A specimen from Mackay Creek (PERTH03776085), whose location in Western Australia is unknown, possibly belongs here, although the style is much longer (10 mm) than the usual range for the taxon (this length of style is unrecorded for any *Tribulus* species in Australia) and the leaflet number (7-8) and width (4-5 mm) are at odds with that recorded for *T. ranunculiflorus*.

**12. *Tribulus cistoides* L.** Species Plantarum 387 (1 May 1753). *Type citation:* Habitat in America calidiore. *Type:* Hermann 1698: 236, t. 236 (*lecto*, *fide* Wijnands 1983: 203).

*Representative specimens examined:* WESTERN AUSTRALIA: One Arm Point township, N Dampierland, *B.J. Carter* 537 (BROOME, CANB, PERTH).  
NORTHERN TERRITORY: 3.5 km NE Victoria River Downs Homestead, 18 Apr. 1996, *D.E. Albrecht* 7434 (AD, DNA, NT); Blue Mud Bay: Yee to Wappah Island, *J. Egan* 2385 (DNA); South West Island, Sir Edward Pellew Group, *G. Wightman* 1581 (CANB, DNA).  
QUEENSLAND: without locality, 1770, *Banks & Solander s.n.* (BM) - specimen seen as photograph in Eichler manuscripts; National Parks Station, Pallarenda, Townsville, 15 Dec. 1980, *B. Jackes s.n.* (CANB).  
PAPUA NEW GUINEA: Cape Suckling, 18 May 1984, *D. Symon* 13807 (AD).

*Distribution and ecology.* *T. cistoides* is mainly confined to coastal localities in northern Australia in Northern Territory and Cape York, with some collections from islands off the Western Australian coast. It is found in deep, sometimes coralline, sand.

*Phenology.* It flowers most months of the year but particularly April to July.

*Distinguishing features.* Usually most easily recognized by its large flowers (petals 15-18 mm long), style (c. 2-3 mm long) longer than stigma and subglabrous fruits, similar in shape to those of *T. terrestris*, but considerably larger. Its restriction to coastal habitats is also a useful distinguishing feature.

*Notes.* Banks and Solander collected this species in 1770, presumably from north-eastern Queensland, where the species persists today. The identification of *T. cistoides* is confirmed by Porter, who worked on the American species of *Tribulus*.

A recent collection from the Victoria River Downs Homestead (*D.E. Albrecht* 7434) agrees entirely with *T. cistoides* specimens from coastal areas and probably indicates that the species is capable of being transported inland and sustaining itself.

*T. cistoides* of south-eastern United States (Porter 1971) and tropical Africa (Launert 1963) is described as having the intrastaminal glands united into a 5-lobed ring. Squires (1969) also suggested that *T. cistoides* has the glands in a ring. This is not in agreement with specimens in Australia here referred to *T. cistoides* since intrastaminal glands have been found to be quite separate. However, Porter also noted that this character breaks down in the Galapagos Islands. From his measurements, style and stigma length of *T. cistoides* in south-eastern United States also appear to be much shorter than those in Australian specimens. *T. cistoides* is predominantly maritime in its locations in the Americas and Africa, in agreement with what has been documented here.

Distinction between the two species *T. cistoides* and *T. zeyheri* apparently rests on the relative length of the style and stigma, with *T. cistoides* having a distinct style, whereas the style in *T. zeyheri* is more or less absent (Launert 1963). Schweickerdt (1937) recognized the two species as distinct but referred to the difficulty in distinguishing them in Africa while Porter (1971), after an examination of specimens from both America and subtropical southern Africa, considered *T. zeyheri* to be a synonym of *T. cistoides*. El Hadidi (1985) separated the two on the style and stigma lengths and also on the pubescence of the plants and the length of the floral peduncle with respect to the subtending leaf; he commented on the difficulty in allocating some inland forms. From notes in Eichler's manuscripts, El Hadidi's annotation on specimens (see under *T. ramunculiflorus* above), and a mention by Wilson (1992a), there has been some thought that *T. zeyheri* might occur in Australia, but there seems to be no material which would support this hypothesis.

*T. cistoides* may well introgress with other species in Australia and Africa and the following notes document its relationship to other members of the *T. terrestris* group in Australia. However, variation in characteristics documented in overseas material (see above) indicates that it is in need of review throughout its range.

#### *T. cistoides* and *T. sp. long-styled eichlerianus*

*Specimens examined.* WESTERN AUSTRALIA: Pier Creek, Warralong Station, *N.T. Burbidge* 826 (PERTH, 2 sheets); 5 km NE of De Grey River crossing on road to Broome, *D.E. Symon* 10100 (AD, PERTH).

*Notes.* Some collections of *T. sp. long-styled eichlerianus*, e.g. *Burbidge* 826 and *Symon* 10100, have fruits more like those of *T. cistoides* with respect to their shape and distribution and number of spines, but they are invariably more pubescent than coastal populations. It may be that *T. sp. long-styled eichlerianus* should be thought of as an inland form of *T. cistoides*, but this needs to be investigated further.

#### *T. cistoides* and *T. occidentalis*

*Specimens examined.* WESTERN AUSTRALIA: North West Cape-lighthouse hill, 31 Aug. 1960, *A.S. George* 1393 (PERTH).



*Notes.* A collection from North West Cape (George 1393) has the majority of fruits of a similar shape to those in *T. cistoides* (and some forms of *T. terrestris* and *T. eichlerianus*). However, these fruits are pubescent whereas those of *T. cistoides* are subglabrous. One other young fruit on this collection appears to be developing spines more characteristic of the fruits of *T. occidentalis*. The specimen serves to illustrate the plasticity in the development of the fruit shape in *Tribulus* species of the *T. terrestris* complex.

*T. cistoides* and *T. terrestris* s.lat.

*Specimens examined.* WESTERN AUSTRALIA: CSIRO Kimberley Research Station, Kununurra, W. Leutert 2 (CANB).

NORTHERN TERRITORY: Beside Stuart Hwy, c. 10 km N of Katherine, E.N.S. Jackson 1047 (AD, CANB).

QUEENSLAND: Sandhurst Bore, Millungera Station, N.H. Speck 4784 (BRI, CANB).

*Notes.* A number of specimens from inland northern Australia possess characteristics of both *T. terrestris* and *T. cistoides* while not really belonging with either species. Their flower size is somewhat intermediate between the species, the style length is too short for *T. cistoides* but longer than that for *T. terrestris* - while the fruits are typical of *T. terrestris* but with a short pubescence all over. They are not *T. zeyheri* as proposed on one of the specimens, since they have styles considerably longer than the stigma (see above), and they are not *T. eichlerianus* since the style is longer than the stigma, the fruits not as densely pubescent as in that species and the spines are as in *T. terrestris*. They might well be treated as the longer styled taxon of *T. terrestris* (q.v.) since this is variable with respect to hair covering on the fruit. However, it should also be noted that Porter (1971) indicated that introgression between *T. cistoides* and *T. terrestris* does occur in Hawaii, facilitated by the endemic carpenter bee, *Xylocopa darwini* Cockerell, and leading to the production of smaller flowers in *T. cistoides*. If a pollinator can be found to be visiting both species in Australia, then the same explanation may well apply here.

**13. *Tribulus eichlerianus* K.L. Wilson, Telopea 5 (1): 21 (1992).** *Type:* Central North: Sandover Highway, 5 km south-west of Utopia turn-off, Northern Territory, 17 April 1983, K.L. Wilson 4646 & R. Barker (*holo:* NSW; *iso:* CANB, NT).

*Specimens examined.* WESTERN AUSTRALIA: Barrow Island, Oct. 1980, R. Buckley 7066 (PERTH); Police Pool Camp, Lennard River, 19 Apr. 1988, R.J. Cranfield 6453 (PERTH); near Roebourne, Oct. 1941, C.A. Gardner s.n. (PERTH); Horse paddock, Gogo, 12 Apr. 1957, C.A. Gardner 10023 (PERTH); S side of Breaden Valley, Southesk Tablelands, A.S. George 15520 (CANB, PERTH); Callawa Creek, upper De Grey River, 26 May 1947, R.D. Royce 1943 (PERTH).

OTHER STATES: see Wilson (1992a).

*Distinguishing features.* *T. eichlerianus* is recognized by the short dense, almost velvety, pubescence on the fruits, the cocci longer than high and each with short median dorsal spines and the stigma longer than the almost absent style.

*Notes.* The fruits of *T. eichlerianus* are a favourite food of the Red-tailed Black Cockatoos (D. Albrecht, pers.comm. 1996).

In describing *T. eichlerianus*, Wilson (1992a) listed selected specimens from Queensland, New South Wales, Northern Territory and South Australia. The species also occurs in Western Australia and extra

specimens are listed here. Across its range the fruits are not always as large as recorded by Wilson, nor are they always as densely pubescent. There is a great deal of variability in the species with respect to the size of the median pair of spines, ranging from almost absent to almost as large as those in *T. cistoides*. A collection from the rocky coasts of Barrow Island (*R. Buckley* 7066) agrees with *T. eichlerianus* in all respects except that the cocci are only sparsely pubescent, while a collection from Southesk Tablelands (*George* 15520, CANB duplicate) has the style on one of the fruits longer than usual for this species.

#### 14. *Tribulus* sp. long-styled *eichlerianus* (*A.S. George* 10666)

?*Tribulus hystrix* (short-spined, smaller fruits) *K.L. Wilson*, *Telopea* 5 (1): 28 (1992).

Prostrate, villous herb, stems up to 40 cm long. Leaves in unequal pairs, more rarely alternate, with 6-8(10) pairs of leaflets above 4-10 mm long petiole; leaflets narrowly elliptic, shortly petiolulate, base oblique, acute, discolorous, villous adaxially, more densely villous abaxially, 6.5-13 mm long, 3-4.5 mm wide. Flowering pedicel 9-28 mm long, upright, fruiting pedicel 14-35 mm long. Sepals 7-10 mm long, glabrous adaxially except for apical pubescence, densely villous abaxially except on hyaline margin. Petals yellow, obovate, glabrous, 15-18 mm long, longer than sepals. Intrastaminal glands 5, indistinct. Stamens 10, at maturity held just below stigma; filaments 3.7-4 mm long; anthers 1.5-1.8 mm long. Ovary densely white pubescent, 5-celled; style 2-4 mm long in flower; stigma 0.6-1.7 mm long. Fruit 8-15 mm high, 11-20 mm wide, dissociating into (3)-5 symmetrical, moderately pubescent, woody cocci, with short tubercles all over, sometimes also with a longer pair of median spines 1.5-4 mm long.

*Specimens examined.* WESTERN AUSTRALIA: Pier Creek, Warralong Station, *N.T. Burbidge* 826 (PERTH, 2 sheets); 19 May 1971, Rudall River, *A.S. George* 10666 (PERTH); Bloodwood Bore, near Balgo, July 1972, *C.H. Gittins* 2452 (BRI); Fanny's Peak, 85 km S of Giles Meteorological Station, 29 Aug. 1973, *B. Lay* 867 (AD); Minderoo Station, Site 28A Landsat Study 7, May 1980, *A.A. Mitchell* 704 (PERTH); Abydos Station, S of Port Hedland, Sep. 1968, *F. Richardson* 19 (PERTH); 17 May 1947, 5 miles N Christmas Creek, Rabbit Proof Fence, *R.D. Royce* 1741 (PERTH); 5 km NE of De Grey River crossing on road to Broome, *D.E. Symon* 10100 (AD, PERTH); Rudall River area, 7 Aug. 1971, *P.G. Wilson* 10297 (CANB - 2 sheets, PERTH).

NORTHERN TERRITORY: On Tanami track, c. 472 km NW of Alice Springs, 140 km S of Rabbit Flat, *P.A. Fryxell*, *L.A. Craven* & *J. McD. Stewart* 4505 (CANB); Rabbit Flat, 42 km SE of Tanami, *D.E. Symon* 6904 (AD).

SOUTH AUSTRALIA: plain between Tomkinson and Mann Ranges, on west face of inselberg, c. 15 km by road NNE of turnoff on Pipalyatjara-Putaputa road, c. ½ km E of Waltjatjata road, 6 Sep. 1978, *N.N. Donner* 6582 (AD, CANB).

*Specimens examined of intermediates.* NORTHERN TERRITORY: 46 miles [c. 74 km] E Mongrel Downs, 20 Apr. 1971, *C.R. Dunlop* 2107 (DNA); Alongside Tanami Creek, 306 miles [c. 490 km] NW of Alice Springs, 20 June 1976, *K. Hunt* 76/38 (NSW).

*Distribution and ecology.* Occurs in the Tanami Desert area of Northern Territory across to the Rudall River and Hamersley areas and south as far as Giles in Western Australia. Little is known of the ecology of this poorly collected taxon. It has been recorded from red clay loam with *Mclaleuca glomerata*, *Aristida* and *Stylobasium*, from stony loam and from hummock grassland in sandstone hills.

*Phenology.* Flowering is recorded from April to August.

*Notes.* One of the reasons for not formally describing the two taxa here delineated by the phrase names *Tribulus* sp. *long-styled eichlerianus* and *T. sp. saline flats*, is the existence of occasional intermediate specimens like *Dunlop* 2107 and *Hunt* 76/38, both from the Tanami Desert. In these collections the fruits show a clear resemblance to those of *T. sp. saline flats* (i.e. small *T. hystrix* type fruits), but the flower size and style and stigma lengths are clearly those of *T. sp. long-styled eichlerianus* or *T. cistoides*. A better understanding is required of the biological significance of and variation in flower size and relative lengths of style and stigma, the ability of the various species of *Tribulus* to cross-pollinate and the outcomes of such crossings, if they do occur, before it can be ascertained whether these are real taxa. The paucity of collections from the inland north west region of Australia also contributes to the lack of understanding of the relationships of the taxa. The large disjunctions in distribution for both of these taxa may be real, and thus cast doubt on the validity of the taxa, or they may just reflect poor collecting in the area.

The fruits of *T. sp. long-styled eichlerianus* resemble those of *T. eichlerianus* but they are less densely pubescent and topped by a much longer style than that found in *T. eichlerianus*. Flower size is much larger than that of *T. eichlerianus*, resembling more the flower sizes of *T. occidentalis* and *T. hystrix*, while the style length is usually much longer than that of the stigma, as is found in *T. hystrix*, except that the style is not as long as in that species. Fruits also bear a strong resemblance to some of the larger fruited central Australian specimens assigned to *T. micrococcus* (q.v.), but the flowers and style length are much smaller in that taxon.

### *Tribulus terrestris* L. complex

*T. terrestris* s. lat. in Australia consists of a number of taxa which overlap in distribution and imperceptibly intergrade in morphology. Three of these taxa, *T. terrestris* s.str., *T. micrococcus* and *T. minutus*, have already been recognized at species level within Australia and it is not proposed to change that classification here, even though it seems doubtful that this status is justified. The group is very much in need of revision both in Australia and world wide. It is a very good candidate for molecular biology study if we wish to understand relationships between the taxa in Australia and their relationship with overseas taxa. Preliminary work on burr morphology (Scott & Morrison 1996a), chromosome counts (Morrison & Scott 1996a) and isozymes (Morrison & Scott 1996b) has led to somewhat conflicting conclusions, but may lend support to the two informal taxa recognized here within *T. terrestris* s.s., based on relative lengths of the style. It is possible that all four taxa may represent long ago introductions of different forms of the species from elsewhere (see for example the varieties of *T. terrestris* recognized by El Hadidi (1972) for Iran, which show a remarkable similarity in attributes to those recognized here), but Scott & Morrison's work suggests that *T. micrococcus*, *T. minutus* and *T. terrestris* (long style) are native to Australia, while *T. terrestris* (short style) is introduced. Since *T. micrococcus* is an octoploid ( $2n = c. 48$ ) according to Morrison & Scott (1996a), it would be interesting to see whether isozyme analysis would also place this taxon with Indian/Kuwaiti collections which also have a chromosome number of 48.

Table 3 gives an indication of the four taxa of the *Tribulus terrestris* complex recognized here and their relationships. Chromosome number and isozyme groups refer to the work of Scott & Morrison as quoted above. The distribution indicated is very approximate and there are many exceptions, which is another factor calling the present taxonomy into question.

Table 3. Comparison of the taxa recognized within Australia in the *T. terrestris* complex.

	approximate distribution	chromosome number	isozyme group	style length (mm)	cocci	cocci spines
<b><i>T. terrestris</i></b> (long style)	northern Australia	24	C	0.6-1.3	not dorsally rounded	long median spines
<b><i>T. terrestris</i></b> (short style)	southern Australia	24/36	A	0-0.3	not dorsally rounded	long median spines
<b><i>T. micrococcus</i></b>	central Australia to Qld	48	?	0.7-1.4	dorsally rounded	median spines lacking or short
<b><i>T. minutus</i></b>	southern Australia	?	?	0.2-0.7	dorsally rounded	median spines lacking or short

*T. micrococcus* and *T. minutus*, with smaller fruits in which the 5 dorsally rounded cocci are usually tuberculate all over and either lacking or with much reduced median spines, have been recognized in the past only from the eastern states of Australia. According to Wilson (1992b) they can be distinguished from *T. terrestris* by stigma characters, but these differences are often not clear cut. Instead, within specimens which have the very long median spines of true *T. terrestris*, there seem to be northern and southern forms based on style length (the longer styles usually found within the northern populations). Similarly within the smaller- and shorter-spined specimens *T. micrococcus* tends to come from more northerly areas than *T. minutus* and also has the longer style. Again, this is only a tendency and there are specimens (e.g. *Dunstan* (AD 96247073) from Adelaide has the longer style of *T. micrococcus*) which do not agree. These smaller- and shorter-spined species are not confined to the eastern states but are to be found throughout Australia, although the fruits are not always as small as in the eastern states. They can usually be distinguished from *T. eichlerianus* because the fruits are smaller and not so densely pubescent, but they resemble that species in the rounded dorsal surface of the coccus and any revision of the complex should also include that species.

There are some specimens which have the attributes of several taxa. For example, some specimens identified as *T. micrococcus*, have fruits approaching *T. eichlerianus* in pubescence, but the length of spines on the fruit are more reminiscent of *T. terrestris*, while the style and stigma lengths are similar to those of *T. micrococcus* (e.g. *P. Canty* 2486, Nullarbor Plain (AD); *M. Cole* 42 & *D. Provan*, Dugald River (BRI)). They might perhaps be better treated as a taxon distinct from the eastern states *T. micrococcus* but they might also be associated with limestone soils. The fruits are very close to those of *T. sp. long-styled eichlerianus* as well, but the flowers are much smaller than those of that species.

Fruits agreeing with one of the smaller-fruited species can sometimes also be found on the same plant as fruits which are closer to *T. terrestris*, e.g. *Perry s.n.*, Doodlakine (CANB).

*T. acanthococcus* may well coincide with *T. minutus* or *T. micrococcus* (see below) but at this stage only a photograph of the type has been seen in the Eichler manuscripts. From Mueller's description, the stigma is only half as long as the style, suggesting that it would be placed either with true *T. terrestris*

or with *T. micrococcus*. If it should prove to belong with the latter then *T. acanthococcus* predates *T. micrococcus*. If it belongs with the former then the occurrence of true *T. terrestris* in Australia was much earlier than the early 1900's indicated by Squires (1969). The type in MEL has still to be studied and lectotypified.

A study of overseas material of *T. terrestris* held at AD indicates that material from the Americas, Africa, Europe and China coincides with the southern Australian form of *T. terrestris*. However, there is a single collection from India which has the longer style of the northern form. This raises the possibility of different introductions of forms of the same species into Australia from overseas or it could possibly indicate the natural occurrence of some of these taxa over a wider area than is currently recognized.

As already mentioned above, there is a possibility that the four taxa recognized below may all relate to the varieties of *T. terrestris*, recognized by El Hadidi (1972) for Iran. Unfortunately it is not possible to discern the style and stigma lengths from the photographs of these varieties. Nor are they documented in El Hadidi descriptions of the taxa and so it is not possible to decide whether these truly coincide with the Australian taxa. If these comparisons can be made in the future then it may give an indication of which taxa can be considered to be truly native to Australia.

One further aspect which has not been addressed is the typification of *T. terrestris*. It has been assumed that the short-styled taxon which is recognized as having been introduced to Australia, coincides with the type of the species, but this could be erroneous. The microfiche of Linnaean types at AD is inadequate to determine such details as style and stigma relationships and there may well be other material which needs to be taken into account in lectotypifying the species. Of the material which is present in the Linnaean herbarium, the sheet LINN 547.2 of *T. lanuginosus* from Ceylon (Sri Lanka) has very robust fruits with long median dorsal spines, and appears very similar to the fruits of the "introduced" specimens of *T. terrestris* in Australia; *T. lanuginosus* is now usually treated as a synonym of *T. terrestris* (see for example Dassanayake 1987). The specimen which is labelled as *T. terrestris* (LINN 547.4), has been cited as the type of the species by Schweickhardt (1937) and by El Hadidi (1985). It has only a single fruit present and it is impossible to make out detail, except to say that it is considerably smaller than that on the *T. lanuginosus* sheet. However Schweickhardt describes the style of *T. terrestris* in his treatment as being "short, much reduced" and El Hadidi as "very short or absent", and since both cite this particular specimen as the type, it is assumed that the type of the name is correctly placed with *T. terrestris* (short style) recognized here.

### 15a. *Tribulus terrestris* (short style)

*Selected specimens examined.* WESTERN AUSTRALIA: Vacant block, opposite Dept Agriculture, Jarrah Road, South Perth, R.J. Cranfield R224 (CANB, PERTH); Mt House Station on Glenroy Road at Adcock River crossing, 5 May 1983, P.A. Fryxell & L.A. Craven 3967 (CANB, PERTH); Broome, K.F. Kenneally 9864 (CANB, PERTH); Camballin, May 1970, Y. Power 820 (PERTH).

NEW SOUTH WALES: Northern outskirts of Jugiong, B.J. Lepschi 798 (CANB, NSW); Scrivener Dam, Canberra, I.R. Telford 10800 (AD, CANB, NSW).

NORTH AMERICA: Madison, Louisiana, 15 June 1978, R. Dale Thomas 58849 & D. Rich 972 (AD); Missouri Pacific Railroad yard south of Desiard St and E of 6th St in Monroe, Ouachita, Louisiana, 18 July 1979, P. Pias 4304 (AD); University Hotel, Davis, Yolo County, California, 26 May 1954, W.D. McLellan 95 (AD); Tarrant Co., Texas, 1 Aug. 1926, A. Ruth 177 (AD); Tucson, Arizona, 20 Oct. 1957, P.O. Schallert 1368 (AD).

SOUTH AMERICA: c. 1 km al norte de Patquia, rumbo a Talamuyuna, Argentinas, 7 Apr. 1959, A.T. Hunziker 14295 (AD).

EUROPE: Italia, 11 July 1969, *A. Charpin et al. s.n.* (AD 97030122); Yugoslavia, Macedonia L Dolina Vardarja, 24 Oct. 1964, *E. Mayer s.n.* (AD 98135009); Corsica, 12 Aug. 1932, *P. Aellen* 128 (AD); East Bulgaria, Varna, 7 Sep. 1953, *N. Vyhodceviskis. n.* (AD 98580847).

ASIA: without locality, *s.dat.*, *R. Schonburgk s.n.* (AD 98146119); Beijing, China, 7 Sep. 1982, *B.B. Wan* 82181 (AD); near the Summer Palace, Beijing, China, 23 July 1986, *B.M. Wang* 053 (AD).

AFRICA: Farm Erfrus, Messina District, Transvaal, 21 May 1982, *E. van Hoepen* 1779 (AD).

AFGHANISTAN: Kalne, 27 May 1969, *J.E. Carter* 323 (AD).

IRAQ: Baghdad Airport, 17 Oct. 1956, *K.H. Rechinger, A.K. Khudairi & R.W. Haines s.n.* (AD).

*Notes.* This taxon represents the introduced component of *Tribulus terrestris*. It is distinguished by the stigma being longer than the practically non-existent (0-0.3 mm long) style and has a predominantly southern distribution except for some specimens from about the Broome-Derby area. Many of the collections are subglabrous but some are villous. *T. terrestris* (short style) appears to grade into *T. minutus*.

Specimens were seen from a number of other countries as listed above. These resembled this taxon closely, particularly those from North America. Specimens from Afghanistan and Baghdad were not so well developed with respect to the dorsal spines on the fruit and tended to be more pubescent, thus showing some approach to *T. minutus*.

#### 15b. *Tribulus terrestris* (long style)

*Selected specimens examined.* WESTERN AUSTRALIA: Bungle Bungle National Park, Ord River at Blue Holes, *K. Menkhorst* 625 (DNA); 9 km N of Kununurra at Mocks Dairy on E side of Ivanhoe Crossing road adjacent to milking parlour, 6 May 1993, *A.A. Mitchell* 3086 (PERTH); Wittenoom Gorge, c. 4 km from Wittenoom, *Hj. Eichler* 22549 (CANB, PERTH).

NORTHERN TERRITORY: 9 miles [14 km] SE Katherine, 7 May 1960, *G. Chippendale s.n.* (NT 6712, PERTH); Mountain Valley Station, Gove Road at Barmguerikba Creek, *T. Henshall* 3903 (DNA); First St, Katherine, 19 June 1964, *D.J. Nelson* 1229 (NT, PERTH).

SOUTH AUSTRALIA: Olympic Dam mine area, *A. Smith per T.J. Fatchen* 391 1164 (AD).

QUEENSLAND: Bruce Hwy, c. 5 km W of Ayr, *J.H. Browne* 583 (CANB).

INDIA: University Campus, Delhi, Mar. 1959, *P. Masand s.n.* (AD 96033083).

*Notes.* This taxon presumably represents the component of *Tribulus terrestris* which is usually cited as native, although, as mentioned above, there has been some Indian material seen which resembles this taxon in its style characteristics. It is characterized by the stigma being shorter than or equal to the distinct (0.6-1.3 mm long) style and has a predominantly northern distribution.

The single Indian specimen seen has a style 1.7 mm long and stigma 1.2 mm long, making the style somewhat longer than is recorded for this taxon in Australia.

**16. *Tribulus minutus*** Leichh. ex Benth., *Flora Australiensis* 1: 291 (30 May 1863). - *Kallstroemia minuta* (Leichh. ex Benth.) Engl. in Engl. & Prantl, *Nat. Pflanzenfam.* 3(4): 88 (1890). *Type citation:* Queensland(?), Leichhardt's Expedition. *Type:* [Queensland, Leichhardt District], before Canal [pastoral run] and afterwards, *s.dat.*, *L. Leichhardt s.n.* (*syn:* MEL *s.n.*, *p.p.*, excluding lower LHS specimen); without locality, *Leichhardt's Expedition, s.dat.*, *Herb. Mueller* (*syn:* K-Herb. Hooker, type seen as photographs in the Eichler manuscripts).

*Specimens examined with typical fruits.* WESTERN AUSTRALIA: Trayning, Gent's Farm, [near Merredin], H.J. Eichler 24208 (CANB).

QUEENSLAND: 17 km from Augathella on Augathella-Tambo road, R.W. Johnson 2200 (BRI).

NEW SOUTH WALES: "Curranyalpa", 1.5 km from Linwood gate, 61 km SW of Louth, C.W.E. Moore 8605 (CANB).

VICTORIA: Irymple, Armagh Court, Karradoc Ave end, between the roadside kerb and the Irymple Sports Ground fence, J.H. Browne 570 (CANB, MEL).

*Specimens examined with larger fruits.* NORTHERN TERRITORY: About half way between Anthony Lagoon and Brunette Downs, 16 May 1947, S.T. Blake 17811 (BRI); Desert Grazing Area, Hamilton Downs, G. Chippendale s.n. (DNA 1755); Petermann Ranges area, P.K. Latz 2401 (DNA 34779); Derwent Station, D. Morgan s.n. (DNA 6674); 14 miles [22 km] S of Erldunda, 10 Mar. 1954, R.E. Winkworth 136 (BRI, CANB).

*Typification.* Both syntypes have been annotated by Bentham.

*Distinguishing features.* As might be expected from the name, fruits of this taxon are smaller than those found in the rest of the *T. terrestris* complex, although larger-fruited specimens, which agree in every other respect, are found in the Northern Territory. The cocci are dorsally rounded and the median pair of spines is very short or even lacking. *T. minutus* has the stigma longer than the practically non-existent style and tends to have a southern distribution.

*Notes.* Central Australian specimens which relate to this taxon (e.g. D. Morgan s.n., Latz 2401 and Chippendale s.n.) have fruits of a similar shape to those of *T. minutus* and *T. micrococcus* but they are larger, being up to 13 mm wide. They seem only to vary from *T. minutus* in size and so have been treated as such here. The fruits superficially resemble the fruits of *T. eichlerianus* but are much less densely pubescent and usually smaller than those of that species.

Dr R.F. Parsons (pers. comm. *in litt.* 24 Sep. 1996) remarked on the fact that Victorian populations of *T. minutus* from Red Cliffs were obviously perennial because of the massive woody rootstocks compared with the clearly annual habit of *T. terrestris*. This character is in need of further investigation in the field across the range of distribution of the species since rootstocks are invariably absent from herbarium collections. S.T. Blake questioned on his collection (Blake 17811) whether the species was a perennial since the base of the plant was woody.

**17. *Tribulus micrococcus*** Domin, *Bibliotheca Botanica* Heft 89: 279 (Oct. 1926). *Type citation*: durftige Grasstellen bei Charters Towers, Savannenwalder bei Pentland, Grassflächen der Rolling Downs bei Nonda (Domin Feb.-Mar. 1910) und wohl verbreitet [Queensland]. *Type*: Rolling Downs apud opp. Nonda [Queensland], Mar. 1910, Domin 5493 (*syn*: PR); Charters Towers [Queensland], Mar. 1910, Domin 5492 (PR); apud opp. Jericho [Queensland], Mar. 1910, Domin 5494 (*syn*: PR). All seen as photographs in the Eichler manuscripts; photographs taken by Bruce Maslin in PR in 1978.

*Specimens examined.* QUEENSLAND: Minerva, S.T. Blake s.n. (BRI, CANB); 8 km along Leyburn road from Pittsworth-Milmerran road, K.L. Wilson 4198 (CANB, NSW).

NEW SOUTH WALES: Myall Creek, 18 km SW of Delungra on road to Bingara, R. Coveny 12582, C. Dunn & J. Plat (CANB, NSW).

*Distribution.* New South Wales and Queensland, extending into central Australia.

*Distinguishing features.* The fruits of *T. micrococcus* are rounded dorsally and usually lacking any dorsal spines. Unlike *T. minutus*, to which it is closely related, *T. micrococcus* usually has a globose stigma, which is considerably shorter than the short (0.7-1.4 mm long), but distinct, style.

*Typification.* Typification of *T. micrococcus* is impossible from the photographs since the detail of the style and stigma is not discernible. It appears from a young fruit present on the collection from Jericho that the style is distinct, thus agreeing with this taxon. However, spines present on the fruit of *Domin* 5493 are 5 mm long, much longer than the usual 2.5 mm long spines of this taxon and so it may be that the syntypes represent a mixed collection.

*Notes.* There is a Leichhardt specimen in MEL (*Leichhardt* 26, MEL *s.n.*) which has been annotated by him as “*Tribulus parviflorus mihi*” from Bokkara Flats on 3rd January 1847. It almost certainly belongs here even though only flowers are present.

The longer style with a short globose stigma as pictured in “*Flora of New South Wales*” (Wilson 1992b) certainly occurs in some specimens of this taxon, but there remain a number of specimens which seem to belong here which have the non-globose stigma as long as the style. It seems unlikely that *T. micrococcus* and *T. minutus* can be maintained as distinct species, although *T. micrococcus* does tend to have larger flowers. Specimens from South Australia, Northern Territory and Western Australia usually have larger and sometimes, spinier fruit than those from eastern Australia, and approach those of *T. eichlerianus* and *T. sp. long-styled eichlerianus*, differing from the former in the less densely pubescent fruits and the latter in the smaller flowers and shorter styles.

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My thanks to the State Herbarium of South Australia, both for the use of facilities and for the opportunity to see a number of these species in the field in Western Australia in 1995, and to Bruce Maslin, Stephen van Leeuwen, Philip Short and Bill Barker, who all contributed in different ways to this field trip.

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**A new species of *Utricularia* (Lentibulariaceae) from the south-west of Western Australia**

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**Abstract**

Lowrie, A. A new species of *Utricularia* (Lentibulariaceae) from the south-west of Western Australia. Nuytsia 12 (1): 37-41 (1998). A new *Utricularia* species, *Utricularia paulineae* Lowrie, is described and illustrated. A key is provided to all the known *Utricularia* species occurring in the south-west of Western Australia.

**Introduction**

*Utricularia paulineae* (Lentibulariaceae) has been treated by previous authors either as *U. inaequalis* A. DC., under the synonymous name *U. hookeri* Lehm. (Erickson 1968) or as a variant of *U. dichotoma* Labill. (Taylor 1989). Extensive study in the field as well as in cultivation has established that the new species here described is morphologically distinct. *Utricularia paulineae* is endemic to the south-west of Western Australia.

**Taxonomy**

**Key to the *Utricularia* species of south-west Western Australia**

- 1 Calyx lobes 4 (subgenus *Polypompholyx*) ..... 2
- 1: Calyx lobes 2 (subgenus *Utricularia*) ..... 4
- 2 Corolla pale pink to white; trap dorsal appendages deeply tridentate ..... **U. westonii**
- 2: Corolla pale pink to bright pink; trap dorsal appendages shortly bifid ..... 3
- 3 Corolla c. 4 mm wide, spur glandular ..... **U. tenella**
- 3: Corolla c. 12 mm wide; spur glabrous ..... **U. multifida**
- 4 Plants with tubers; corolla red ..... **U. menziesii**
- 4: Plants without tubers; corolla yellow, violet or pale lilac ..... 5
- 5 Plants free-floating; corolla yellow ..... 6
- 5: Plants affixed aquatics; corolla violet or pale lilac ..... 7

- 6 Ultimate segments of the leaves many; pedicels pendulous in fruit ..... **U. australis**  
 6: Ultimate segments of the leaves very few; pedicels semi-erect in fruit ..... **U. gibba**  
 7 Inflorescence peduncle twining around nearby herbs for support ..... 8  
 7: Inflorescence peduncle erect ..... 9  
 8 Corolla *c.* 20 mm wide; palate bearing 2 raised yellow ridges ..... **U. volubilis**  
 8: Corolla *c.* 5 mm wide; palate bearing 3 raised yellow ridges ..... **U. helix**  
 9 Inflorescence peduncle bearing 2-4 scales; corolla pale lilac ..... **U. simplex**  
 9: Inflorescence peduncle without scales; corolla lower lip violet ..... 10  
 10 Corolla upper lip pale lemon ..... 11  
 10: Corolla upper lip violet ..... 12  
 11 Corolla lower lip reniform; spur longer than the lower corolla lip ..... **U. paulineae**  
 11: Corolla lower lip semi-circular in outline with the apex 3-lobed; spur shorter  
 than the lower corolla lip ..... **U. benthamii**  
 12 Leaf lamina linear-cuneate, apex rounded; bracts and bracteoles 2 ..... **U. violacea**  
 12: Leaves narrowly linear, apex acute; bracts and bracteoles 3 or more ..... 13  
 13 Corolla upper lip divided V-shaped into 2 oblong lobes, apex rounded;  
 palate bearing *c.* 8 prominent yellow slightly raised ridges and streaks ..... **U. inaequalis**  
 13: Corolla upper lip obovate, apex truncate and slightly emarginate; palate  
 bearing 2 prominent yellow ridges mostly with a smaller ridge between ..... **U. dichotoma**  
 (Western Australian form)

***Utricularia paulineae* A. Lowrie, *sp. nov.***

*Utriculariae dichotomae* Labill. affine sed corolla labio inferiore violaceo, reniformi, labio superiore pallide citrino, flabellato, calcare labiam inferius superenti; utricularae appendice dorsali supra orem brevissimis, truncato-dentata, capsula calycis lobis brevior.

*Typus:* 22.1 km north of Augusta, Western Australia, 34° 08' 11" S, 115° 06' 53" E, 7 December 1996, A. Lowrie 1655 (*holo:* PERTH 04680510; *iso:* MEL).

Perennial *herb*, terrestrial, up to 60 cm in diam., leaves in groups of 4 with rhizoids and traps at the base along numerous branching stolons many cm long and situated just below the soil surface to *c.* 1 cm in depth. *Leaves* spatulate (including the petiole), 7-10 mm long; lamina obovate, 2-3 mm long, 1.2-1.8 mm wide; petiole 0.5-0.7 mm wide. *Traps* on a long slender stalk, bilaterally compressed, *c.* 1.3 mm long, *c.* 1 mm wide in side view, to *c.* 0.7 mm wide in dorsal view; dorsal appendage above the mouth very short, truncate and apically dentate; lateral appendages winged with the leading edges dentate; ventral wings marginally dentate. *Inflorescence* erect, arising from a cluster of 4 leaves, 7-20 cm long (including peduncle); peduncle terete, 0.4-0.5 mm diam., glabrous, without scales. *Bracts and bracteoles* basisolite; bracts single, narrowly ovate, 1.5-2 mm long, 0.7-0.9 mm wide, apex rounded, base truncate  $\pm$  3-lobed; bracteoles paired, opposite, lanceolate, 1.5-2 mm long, 0.25-0.3 mm wide, apex rounded, base narrower, oblong. *Flowers* 1 or 2, pedicels 8-10 mm long. *Calyx lobes* 2, unequal; upper lobe obovate, 3-4.5 mm long, 2-3.5 mm wide; lower lobe broadly obovate, 2-4 mm long, 1.6-4 mm wide, apex emarginate. *Corolla* 7-11 mm long (not including the nectary spur), 10-14 mm wide, both lips slightly crenulate, lower lip violet or rarely white, reniform, 5.5-7 mm long, 10-14 mm wide; upper lip pale lemon, flabellate, 2.5-3 mm long, 4-5 mm wide at the apex, 1.3-1.8 mm wide at the base. *Palate* bearing 5 raised

ridges, the central ridge yellow, c. 0.4 mm long, slightly raised and situated between a pair of yellow raised ridges c. 0.8 mm long, bordered by a violet raised ridge c. 1.2 mm long and c. 0.4 mm wide on each side of the palate, additionally with a pale lemon zone between the outer ridges and a short distance below the central ridges. *Spur* longer than and positioned at 90° to the lower corolla lip, adaxial surface whitish, abaxial surface violet, yellowish at the apex, pyriform, 6–8 mm long, 1.5–2 mm wide at the apex, 2.5–3 mm wide in the middle, 2.7–3 mm wide at the base. *Capsule* obovoid, c. 3.5 mm long, dehiscing by a longitudinal slit. *Seeds* brown, c. 0.4 mm long, testa reticulate. (Figure 1)

*Selected specimens examined.* WESTERN AUSTRALIA: 3.5 km ENE of Walpole, 14 Dec. 1987, A.R. Annels 140 (PERTH); 8 km W of Walpole, 8 Mar. 1989, A.R. Annels 740 (PERTH); 34°08'31"S 115°09'08"E (c. 10 km NE of Karridale), 18 Nov. 1992, A.R. Annels 3052 (PERTH); c. 7 km N of Karridale, 2 Jan. 1985, A. Lowrie & P. Lowrie s.n. (PERTH); edge of Walpole-Nornalup National Park, c. 2 km W of Walpole, 27 Jan. 1993, J.R. Wheeler & S.J. Patrick 3774 (PERTH); Walpole-Nornalup National Park, 27 Jan. 1993, J.R. Wheeler & S.J. Patrick 3802 (PERTH).

*Distribution.* Recorded from the southern coastal region of south-west Western Australia between Karridale and Walpole.

*Habitat.* *Utricularia paulineae* grows in peaty sand on swampland flats and creek margins with *U. simplex* R. Br., *Drosera hamiltonii* C.R.P. Andrews, *D. pulchella* Lehm., *Cephalotus follicularis* Labill. and *Reedia spathulata* F. Muell. Commonly found in the bare densely shaded areas under swampland *Melaleuca* scrub.

*Phenology.* The frequency of *Utricularia paulineae* specimens in flower is generally low. Increased numbers of flowering plants were observed at three locations where a natural or man-made disturbance of the habitat had occurred; on the margins of the Shannon River after a fire; at Karridale where swampland vegetation had been cleared for agriculture alongside a creek margin; and nearby in the same area in swampland that had been cleared for power lines. This species, like many other swampland species, may need the occasional services of naturally occurring fire, such as caused by lightning strike, to clear the habitat of dense vegetation so mass flowering can occur.

*Conservation status.* *Utricularia paulineae* is currently not under threat. It is an inconspicuous species but is locally abundant at known localities.

*Etymology.* *Utricularia paulineae* is named in honour of my wife and research assistant Pauline Lowrie who discovered *U. paulineae* in the field while we were botanising at the type location area north of Karridale.

*Affinities.* The closest relatives to *Utricularia paulineae* in south-west Western Australia are *U. benthamii* P. Taylor and *U. dichotoma* Labill. *U. paulineae* is distinguished from *U. benthamii* (whose characters are given in parentheses) by having a corolla lower lip reniform, apex entire (semicircular in outline, apex 3-lobed) and spur longer than the corolla lower lip (shorter than the corolla lower lip). *U. paulineae* is distinguished from *U. dichotoma* (whose characters are given in parentheses) by having a violet, reniform corolla lower lip and a pale lemon, flabellate upper lip (lower lip depressed-obovate, upper lip obovate, apex emarginate, both corolla lips violet); spur longer than the lower lip of the corolla (spur shorter than the lower lip); trap dorsal appendage above the mouth very short, truncate-dentate (trap dorsal appendage subulate, simple); and capsule shorter than the calyx lobes (as long as or slightly longer).

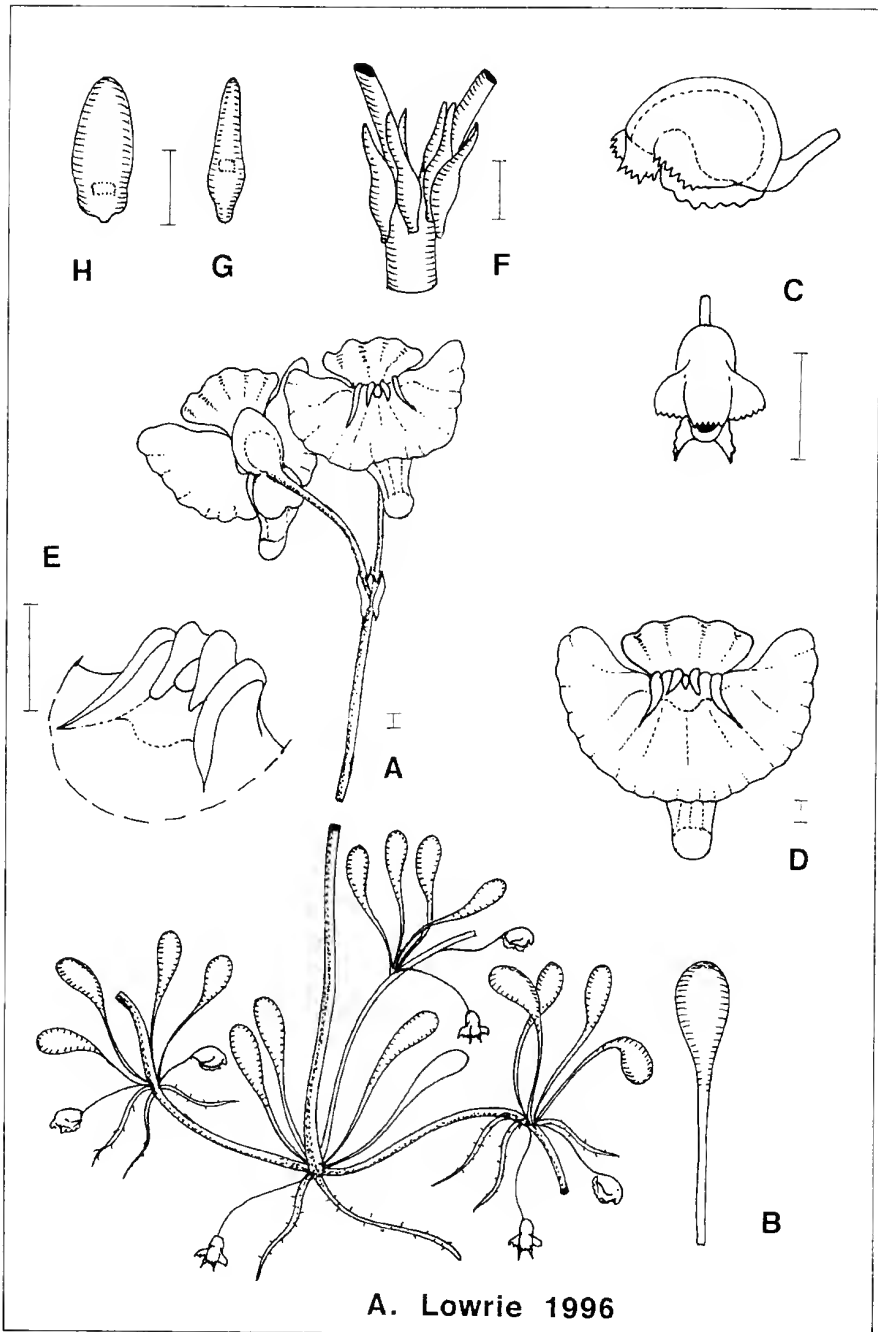


Figure 1. *Utricularia paulineae* A - habit of flowering plant; B - leaf; C - side view of trap above, front view of trap below; D - corolla; E - corolla palate, enlarged; F - bracts and bracteoles positioned about the pedicels above, and the peduncle below; G - bracteole; H - bract. Scale bar for all = 1 mm. Drawn from A. Lowrie 1655.

*Notes.* I first became aware of *Utricularia paulineae* in 1985 and located further populations at the Shannon River and Walpole in 1987.

In 1989 Rica Erickson granted me access to all her original botanical illustrations and field notes. Amongst Rica's drawings I found two separate pencil sketches with measurements and notes comparable to *U. paulineae*. Both illustrations are labelled *Utricularia hookeri* (*U. inaequalis* A. DC.). Only one sheet has location notes "Swamp  $\pm$  12 m (19.2 km) east of Alexandra Bridge, 7 Jan 1962 with pitcher plants (*Cephalotus follicularis* Labill.) + *Drosera*".

### Acknowledgements

I would like to thank Rica Erickson, author of "Plants of Prey", "Triggerplants" and "Orchids of the West" for providing the initial inspiration for my continuing passion for carnivorous plants, triggerplants and orchids; for allowing me to study, as well as make copies of all her original botanical drawings, working pencil drawings, field notes etc. of all her botanical research from 1932 onwards.

I would like to also thank Paul Wilson for his assistance with the Latin diagnosis; the referee Peter Taylor for his suggestions and comments; Barbara Rye for her comments, and the staff of the Western Australian Herbarium.

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## A taxonomic review of the *Stylidium caricifolium* complex (Stylidiaceae), from south-west Western Australia

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### Abstract

Lowrie, A., Coates, D.J. and Kenneally, K.F. A taxonomic review of the *Stylidium caricifolium* complex (Stylidiaceae), from south-west Western Australia. Nuytsia 12 (1): 43-57 (1998). A taxonomic review of the *Stylidium caricifolium* Lindl. complex (Stylidiaceae) is presented. Six species are recognized, including the new taxa, *S. maritimum*, *S. sejunctum* and *S. wilroyense* Lowrie, Coates & Kenneally. Additionally, *S. affine* Sond. and *S. nungarinense* S. Moore are restored to species rank. Recognition of these species is supported by chromosome, allozyme, ecological, geographical and morphological evidence. All six taxa are endemic to south-west Western Australia.

### Introduction

*Stylidium affine* and *S. caricifolium* were recognized as species in the major taxonomic review of the Stylidiaceae by Milbraed (1908). Subsequently *Stylidium nungarinense* was described by Moore (1920) as an inland species closely related to *S. affine* and *S. caricifolium*. However, Carlquist (1969) contended that *S. nungarinense* was identical to *S. caricifolium* except in the hairiness of the leaves and should be reduced to subspecies. Similarly he suggested that *S. affine* differed from *S. nungarinense* only in flower colour and geographical distribution and it too should be reduced to subspecies.

Although *Stylidium affine*, *S. caricifolium* and *S. nungarinense* are clearly related, biosystematic studies (Coates 1982) indicate that they are all quite distinct species. This is supported by data presented here. In this paper *S. affine* and *S. nungarinense* are reinstated as species. Three new species related to *S. caricifolium* are named. All six species are described and illustrated and are referred to here as the *Stylidium caricifolium* complex. They form part of a larger group that belongs to subgenus *Tolypangium* Endl., section *Squamosae* Benth. (Mildbraed 1908). All members of section *Squamosae* are characterized by having graminiform, linear, lanceolate or oblanceolate-linear leaves intermixed with shorter scarious scales. The group is commonly referred to as Scale-leaved Triggerplants, a name adopted by us but first used by Rica Erickson (1958).

## Cytogenetics and geographic distributions

Three different chromosome numbers are found in the *Stylidium caricifolium* complex,  $n = 6$  (*S. sejunctum*),  $n = 7$  (in *S. affine*, *S. caricifolium* and *S. maritimum*), and  $n = 8$  (in *S. nungarinense* and *S. wilroyense*). In addition, detailed karyotype analysis on species with the same chromosome number has shown that with the exceptions of *S. caricifolium* and *S. affine*, karyotype differences between species are extensive and the karyotypes are generally stable throughout the geographic range of each species (Coates 1995; Coates & James 1996). Figure 1 shows the known distributions of the six species and illustrates their karyotypes. All species pairs are apparently either allopatric or parapatric in distribution except for *S. nungarinense* and *S. sejunctum*, which show a small overlap in range.

## Taxonomy

### Key to the species in the *Stylidium caricifolium* complex

- 1 Leaf bases surrounded by dense woolly hairs; peduncles 1-flowered ..... ***S. wilroyense***
- 1: Leaf bases not surrounded by dense woolly hairs; peduncles (1)2-6-flowered ..... 2
- 2 Leaves 1 per papery sheath ..... ***S. nungarinense***
- 2: Leaves 2-5 per papery sheath ..... 3
- 3 Leaves scabrid; corolla white ..... ***S. caricifolium***
- 3: Leaves glabrous; corolla pale pink to rose or mauve ..... 4
- 4 Corolla pale pink; occurs inland east of Hyden ..... ***S. sejunctum***
- 4: Corolla rose pink to mauve; occurs along the west coast and inland to Kojonup ..... 5
- 5 Inflorescence 40-55 cm long including scape; peduncles 3-6-flowered.  
Lower throat appendages *c.* 3 mm long, white and green with 2 free tips red.  
Occurs in coastal regions along the west coast from Lancelin to south  
of Mandurah ..... ***S. maritimum***
- 5: Inflorescence 20-30 cm long including scape; peduncles 1-3-flowered.  
Lower throat appendages *c.* 1.5 mm long, white. Occurs from east of  
Gingin to south-east of Kojonup and west to Dunsborough ..... ***S. affine***

***Stylidium affine*** Sond. (Sonder: 1845: 371). - *Stylidium caricifolium* Lindl. subsp. *affine* (Sond.) Carlquist (Carlquist 1969: 56). *Type*: In confragosis montium continuorum Darling's Range, Perth, [Western Australia], September 1841, Herb. Preiss. No. 2291 (*lecto*: here designated: LD).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves in groups of 2-4 arising from a basal papery sheath. *Leaves* lanceolate, 12-30 cm long, 2-4 mm wide, midrib visible on both the adaxial and abaxial surfaces, margins revolute, glabrous. *Inflorescences* paniculate, including scape 20-30 cm long, densely glandular-pubescent; peduncles 1-3-flowered, the basal ones sometimes 8-10 cm long, mostly 2.5-5 cm long, the upper ones shorter; bracts linear, 4-6 mm long; bracteoles 1.5-3 mm long. *Hypanthium* ellipsoid at anthesis, 4.5-6 mm long, 1.5-3.5 mm wide, densely glandular-pubescent. *Sepals* 4.5-5 mm long, 3 free to the base, 2 joined for half of their length or all free to base, glandular-pubescent. *Corolla* rose pink to mauve, lobes vertically paired; anterior lobes 8-11 mm long, 4.5-9 mm wide; posterior lobes 8-11 mm long, 5-8 mm wide. *Labellum* obovate, apex with a rounded lobe, dark pink, *c.* 1.9 mm long, *c.* 1.6 mm wide, papillose, with 2 basal subulate appendages; appendages white, tips dark pink,

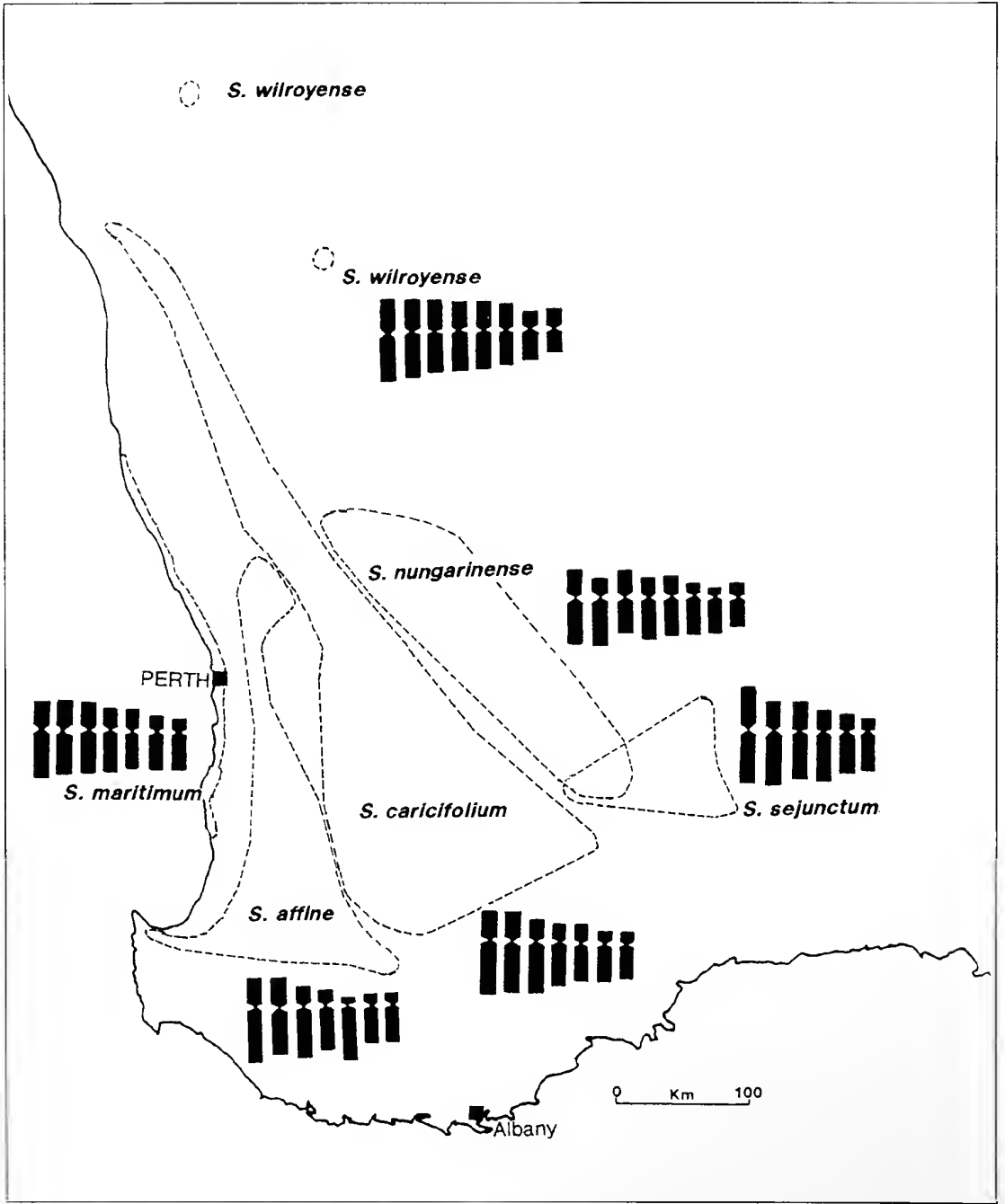


Figure 1. Geographic ranges and karyotypes for *Stylidium affine*, *S. caricifolium*, *S. maritimum*, *S. nungarinense*, *S. sejunctum* and *S. wilroyense*.

*c.* 1 mm long, papillose; boss ovate, white, smooth, *c.* 1.5 mm long, *c.* 0.8 mm wide. *Throat appendages* 4; upper 2 wing-like, white at the base, pink towards the apex, *c.* 4 mm long; lower 2 narrowly ovate, bifurcate, white, papillose, fused along their length at the base and rolled together to form one point at the apex, *c.* 1.5 mm long. *Gynostemium* 10.5-13.5 mm long. *Capsule* ellipsoid, slightly laterally compressed, 7-9 mm long, 5.5-6.5 mm wide. (Figure 2)

*Selected specimens examined.* WESTERN AUSTRALIA: Reserve Road, Muchea, 31° 28' S, 116° 00' E, 1 Oct. 1988, *A. Lowrie s.n.* (PERTH); midway along Wandena Road, Muchea, 31° 42' S, 116° 04' E, 7 Oct. 1989, *A. Lowrie s.n.* (PERTH); Kalamunda, 10 Oct. 1926, *A. G. Nichols s.n.* (PERTH); Darlington, 18 Oct. 1931, *R. E. Williams s.n.* (PERTH).

*Distribution.* *Stylidium affine* is found from east of Gingin in the north, south-east to Kojonup and west to Dunsborough. (Figure 1)

*Habitat.* Grows in lateritic soils often associated with granite outcrops in open Wandoo (*Eucalyptus wandoo*) woodland. In the southern part of its range, *Stylidium affine* tends to be found in low lying areas associated with open Wandoo or Marri (*Corymbia calophylla*) woodland.

*Flowering period.* October.

*Conservation status.* A common species found over a range of at least 300 km.

*Chromosome number.*  $n = 7$  (Coates 1982).

*Affinities.* Closely related to *Stylidium maritimum* but tends to have more leaves per papery sheath, and the leaves are usually shorter. Other differences are given in the key.

***Stylidium caricifolium* Lindl.** (Lindley 1839: 28). *Type:* *Drummond s.n.* (CBG).

*Stylidium affine* var. *laxum* Pritz. (in Diels & Pritzel 1905: 589). *Type:* In distr. Irwin pr. Mingenew in locis glareosis apertis flor. m. Sept. [near Mingenew, Western Australia], September, *Diels* 4249 (*n. v.*).

*Stylidium affine* var. *minus* Sonder (in Lehmann 1845: 371). *Type:* In glareosis sterilibus districtus Hay [Western Australia], November 1840. (*n. v.*).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves in groups of 2 (rarely 3) arising from a basal papery sheath. *Leaves* linear-lanceolate, 10-26 cm long, 1-5 mm wide, margins revolute, midrib visible on both the adaxial and abaxial surfaces, adaxial surface striate, with glassy epidermis cells in the glabrous longitudinal valleys and scabrid indumentum on the longitudinal ridges, abaxial surface glabrous except for the slightly scabrid midrib. *Inflorescences* paniculate, including scape 12-35 cm long, densely glandular-pubescent; peduncles 1-3-flowered, the basal ones 2.5-4.5 cm long, the upper ones shorter; bracts linear, 5-10 mm long; bracteoles 2-3 mm long. *Hypanthium* ellipsoid at anthesis, 4-7 mm long, 2-3.5 mm wide, densely glandular-pubescent. *Sepals* 3-4 mm long, 3 free to the base, 2 joined for half of their length, glandular-pubescent. *Corolla* white, lobes vertically paired; anterior lobes 7-13.5 mm long, 5-10 mm wide; posterior lobes 5-10 mm long, 2-5 mm wide. *Labellum* ovate, white, margins mauve, *c.* 1.3 mm long, *c.* 0.7 mm wide, papillose, with 2 basal terete appendages; appendages mauve, tips purple, *c.* 1 mm long, papillose; boss suborbicular, white, *c.* 0.7 mm long, *c.* 0.7 mm wide, smooth. *Throat appendages* 4; upper 2 wing-like, white *c.* 5 mm long; lower 2 narrowly ovate, bifurcate, white,

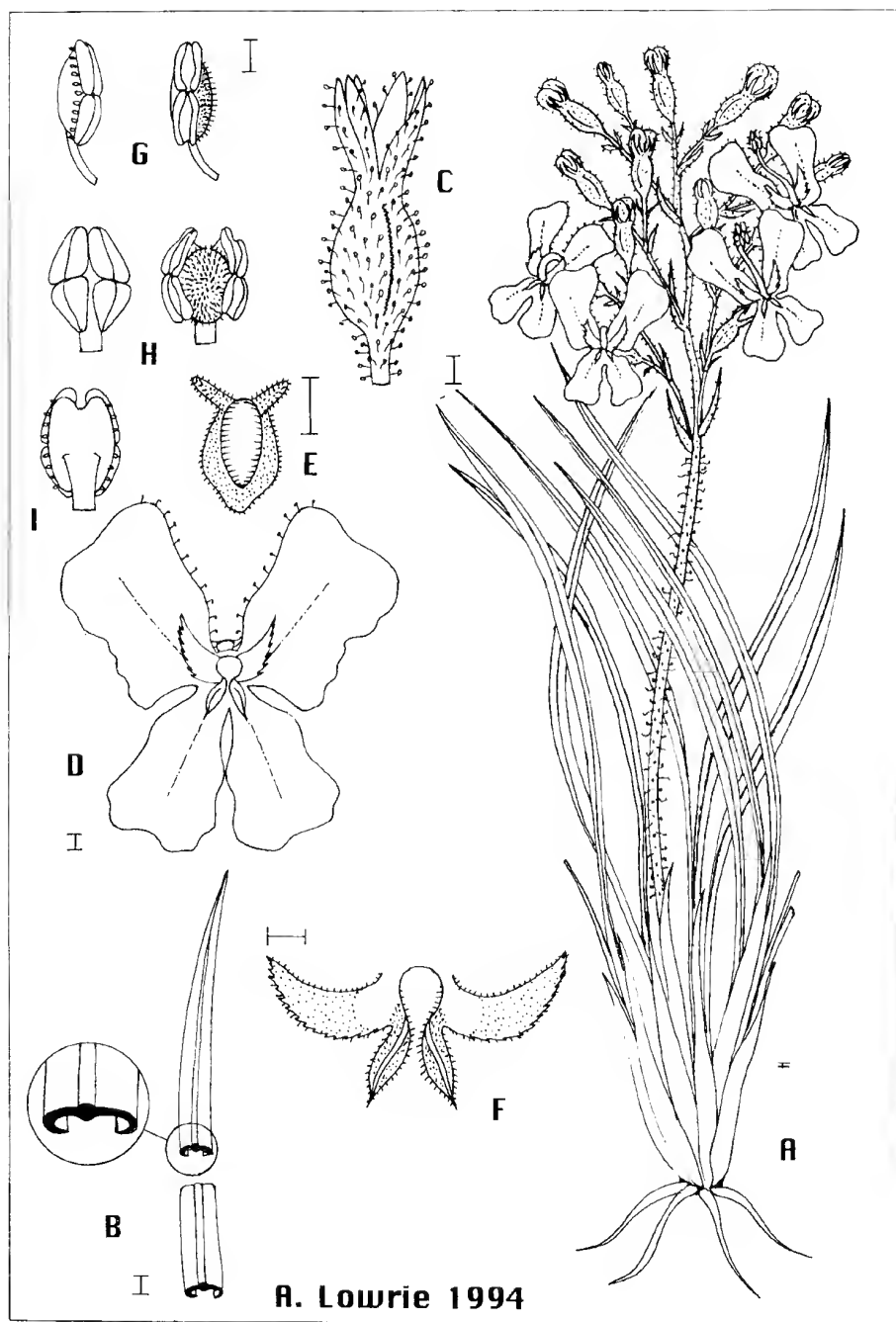


Figure 2. *Stylidium affine* A - habit of flowering plant; B - leaf, enlarged section left; C - hypanthium; D - corolla; E - labellum; F - throat appendages; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie s.n. 7 Oct. 1989.

papillose, fused together at the base, tips red, free and pointed, *c.* 2 mm long. *Gynostemium* 10.5-15 mm long. *Capsule* ellipsoid, slightly laterally compressed, 9-11 mm long, 4.5-5.5 mm wide. (Figure 3)

*Selected specimens examined.* WESTERN AUSTRALIA: Quairading to York road, 20 Sep. 1966, *R. Filson* 8959 (MEL, PERTH); Tarin Rock, 11 Oct. 1966, *R. Filson* 9382 (PERTH); Corner of Bolgart West Road and Pither Road, *c.* 8 km NW of Bolgart, 31° 13' S, 116° 27' E, 18 Oct. 1988, *A. Lowrie s.n.* (PERTH); on The Midlands road, 12.2 km NW of Three Springs, 29° 38' S, 115° 50' E, 22 Sep. 1990, *A. Lowrie s.n.* (PERTH).

*Distribution.* *Stylidium caricifolium* is the most widespread species in the complex and is found over a wide area of the wheatbelt from Walkaway near Geraldton south to Kojonup and east to Lake Grace. (Figure 1)

*Habitat.* Grows in lateritic soils in open Wandoo woodland, Marri woodland and *Allocasuarina* scrub.

*Flowering period.* September-October.

*Conservation status.* A common species found over a range *c.* 600 km through much of the Western Australian wheatbelt region.

*Chromosome number.* *n* = 7 (Coates 1982).

*Affinities.* Closely related to *Stylidium affine*, *S. maritimum*, *S. nungarinense* and *S. sejunctum* but differs by having scabrid leaves. Other differences are given in the key.

*Notes.* The type locations for *Stylidium affine* var. *laxum* and *S. affine* var. *minus* fall within the geographic range for *S. caricifolium*.

***Stylidium maritimum* Lowrie, Coates & Kenneally, *sp. nov.***

*S. affine* Sond. affini sed foliis 2 (raro 3) per vaginam papyraceam, 2-5 mm latis, 20-40 cm longis, inflorescentia scapo incluso 40-55 cm longo, pedunculis 3-6-floris differt.

*Typus:* Limestone quarry on Yeal Swamp Road *c.* 3 km east of Wanneroo-Lancelin road, Yanchep, Western Australia, 31° 31' S, 115° 41' E, 22 October 1995, *A. Lowrie* 1357 (*holo:* PERTH 04430913; *iso:* MEL).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves in groups of mostly 2 (rarely 3) arising from each basal papery sheath. *Leaves* lanceolate, 20-40 cm long, 2-5 mm wide, midrib visible on both the adaxial and abaxial surfaces, margins curved but not revolute, glabrous. *Inflorescences* paniculate, including scape 40-55 cm long, densely glandular-pubescent; peduncles 3-6-flowered, the basal ones 2-3 cm long, the upper ones shorter; bracts linear, 5-8 mm long; bracteoles 1.5-2 mm long. *Hypanthium* ellipsoid at anthesis, 5.5-7 mm long, 3-3.5 mm wide, densely glandular-pubescent. *Sepals* 3-4.5 mm long, 3 free to the base, 2 joined for two thirds of their length (rarely free to the base), glandular-pubescent. *Corolla* rose pink, lobes vertically paired; anterior lobes 9-11 mm long, 5-6.5 mm wide; posterior lobes 7-10 mm long, 3.5-5.5 mm wide. *Labellum* ovate, mauve, *c.* 1.6 mm long, *c.* 0.9 mm wide, papillose, margins bearing a few long hair-like stalked glands, with 2 basal subulate appendages, apex acute; appendages mauve with a purple apex, *c.* 1.5 mm long, papillose; boss elliptic, mauve,

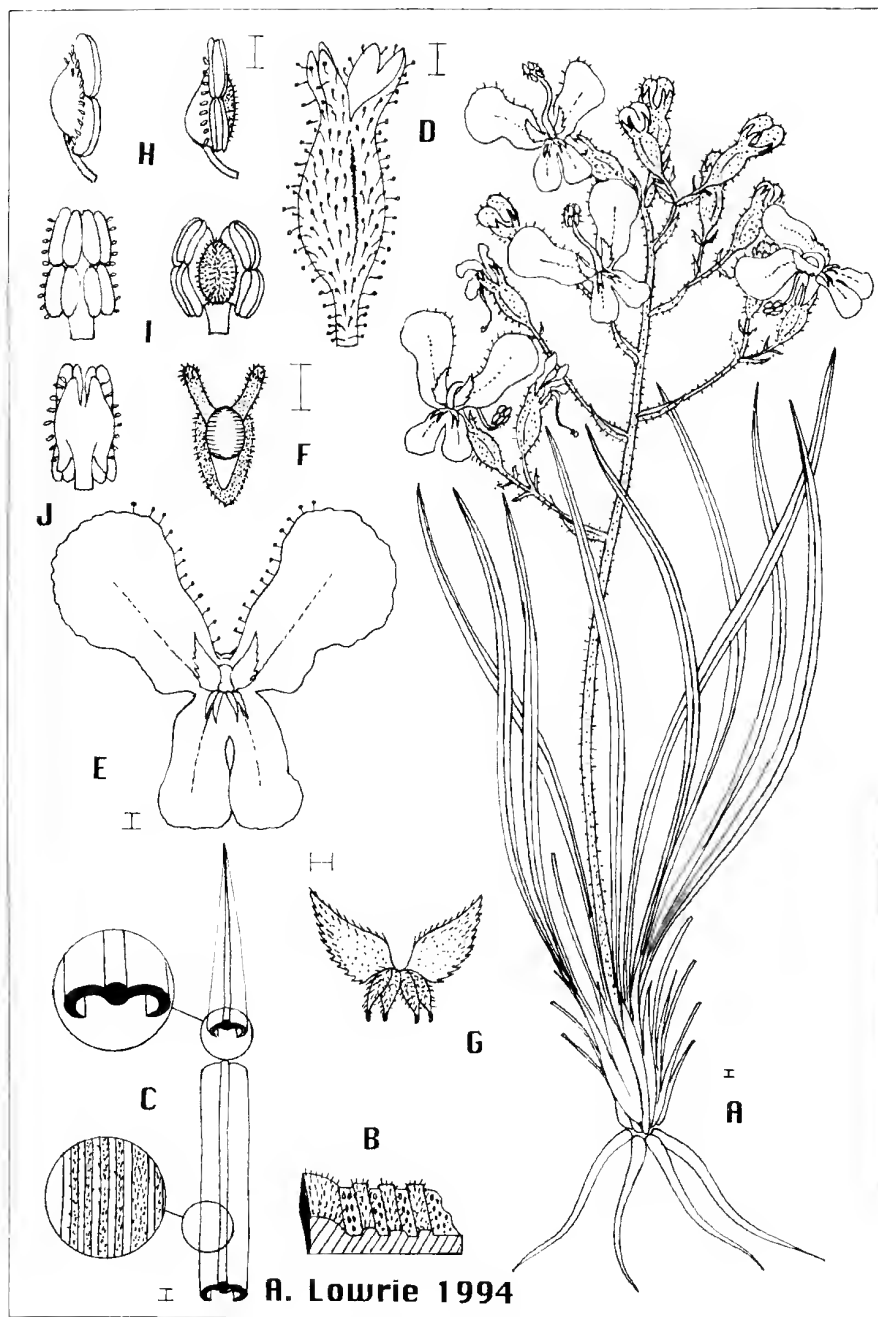


Figure 3. *Stylidium caricifolium* A - habit of flowering plant; B - part section of the striate adaxial leaf surface with half of the midrib on left, showing the glassy epidermis cells in the glabrous longitudinal valleys and the scabrid indumentum on the longitudinal ridges; C - leaf, enlarged section left; D - hypanthium; E - corolla; F - labelium; G - throat appendages; H - lateral view of gynostemium tip (with stigma at right); I - front view of gynostemium tip (with stigma grown out, right); J - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie s.n. 18 Oct. 1988.

*c.* 1.2 mm long, *c.* 0.7 mm wide, smooth. *Throat appendages* 4; upper 2 wing-like, white at the base, pink towards the apex, red margined at the base, *c.* 4 mm long; lower 2 narrowly ovate, bifurcate, white and green on the united base and with two long red points, *c.* 3 mm long. *Gynostemium* 9-13 mm long. *Capsule* ellipsoid, slightly laterally compressed, 8-9 mm long, 5-6 mm wide. (Figure 4)

*Selected specimens examined.* WESTERN AUSTRALIA: Pinnacles, 37 miles [60 km] N of Lancelin, Oct. 1971, *S. James s.n.* (PERTH); Just N of the Tavern on Wanneroo Rd, Carabooda, 31° 37'S, 115° 44' E, 22 Oct. 1995, *A. Lowrie* 1358 (PERTH); Claremont, 21 Oct. 1899, *A. Morrison* (K); Cottesloe, 21 Oct. 1899, *A. Morrison* (K).

*Distribution.* *S. maritimum* occurs from Lancelin in the north, southwards to Yalgorup National Park south of Mandurah. (Figure 1)

*Habitat.* Grows on limestone outcrops in crater-like depressions filled with black sandy soil surrounded by low coastal heath and open *Banksia menziesii* woodland, on consolidated white coastal sand dunes amongst low heath.

*Flowering period.* October-November.

*Conservation status.* CALM Conservation Codes for Western Australian Flora: Priority Three. Restricted to coastal dunes between Cervantes and Yalgorup. This species occurs in a habitat particularly prone to land clearing and development. Four populations are known from national parks.

*Chromosome number.*  $n = 7$  (Coates 1982).

*Etymology.* The epithet, *maritimum* is from the latin *maritimus* - growing by the sea, in reference to this species being found in coastal habitats.

*Affinities.* Closely related to *Stylidium affine* and Carlquist (1969) considered it to be merely a sand-inhabiting variant of that taxon. However, it differs in its longer leaves; 3-6-flowered peduncles; ovate labellum bearing a few long hair-like stalked glands on the margins as well as longer basal appendages; and longer lower throat appendages with two long, free points.

***Stylidium nungarinense*** S. Moore (Moore 1920: 183). (*Stylidium caricifolium* subsp. *nungarinense* (S. Moore) Carlquist (Carlquist 1969: 54). *Type:* Nungarin, Western Australia, Stoward 785 (*holo:* BM).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves singly arising from each basal papery sheath. *Leaves* lanceolate, 10-28 cm long, 2-7 mm wide, midrib visible but not prominent on both the adaxial and abaxial surfaces, adaxial surface striate, smooth, with glassy epidermis cells in the longitudinal valleys, margins curved but not revolute, glabrous. *Inflorescences* paniculate, including scape 12-35 cm long, densely glandular-pubescent; peduncles mostly 2-flowered (rarely 1- or 3-flowered), the basal ones 2.5-3 cm long, the upper ones shorter; bracts linear, 2-5 mm long; bracteoles 1.5-2 mm long. *Hypanthium* narrowly ellipsoid at anthesis, 4-6 mm long, 1.5-2.3 mm wide, densely glandular-pubescent. *Sepals* 3-4 mm long, free to base, glandular-pubescent. *Corolla* white to pale pink, lobes vertically paired; anterior lobes 8-11 mm long, 5-8 mm wide; posterior lobes 5.5-7.5 mm long, 1.5-3.5 mm wide. *Labellum* ovate, white, *c.* 1.5 mm long, *c.* 0.8 mm wide, papillose, with 2 basal terete appendages, apex acute; appendages white with red tips, *c.* 0.6 mm long, papillose; boss widely elliptic, white, *c.* 0.6 mm long, *c.* 0.5 mm wide, smooth. *Throat appendages* 4; upper 2 wing-like, white, *c.* 5 mm



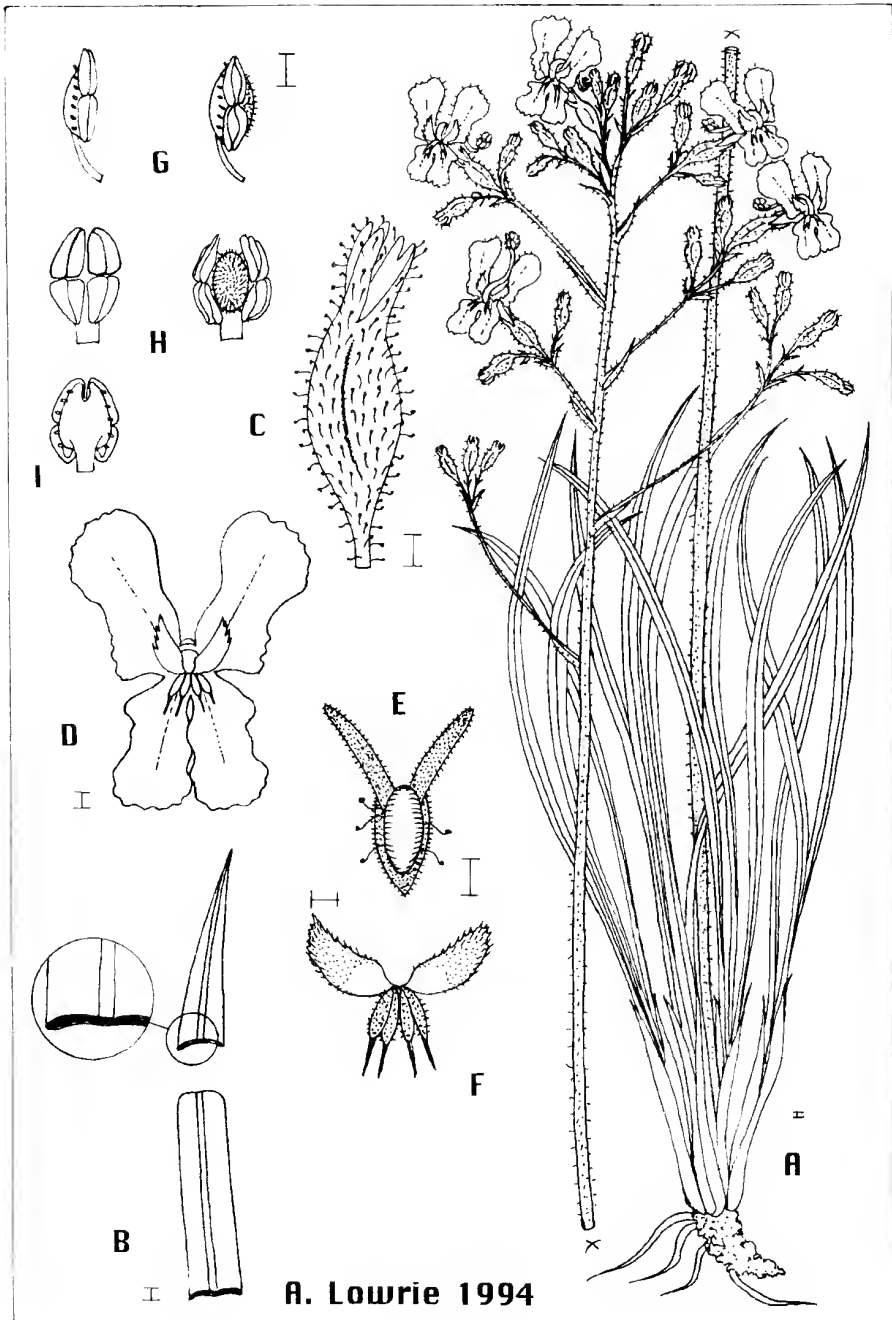


Figure 4. *Stylidium maritimum* A - habit of flowering plant; B - leaf, enlarged section left; C - hypanthium; D - corolla; E - labellum; F - throat appendages; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie 1357.

long; lower 2 narrowly ovate, bifurcate, white, red-tipped, c. 1.8 mm long, papillose. *Gynostemium* 9-12 mm long. *Capsule* ellipsoid, slightly laterally compressed, 8-9.5 mm long, 5-6 mm wide. (Figure 5)

*Selected specimens examined.* WESTERN AUSTRALIA: 10.4 km S of the Yandanooka West Road junction, 3 Oct. 1986, *D. Coates* VA2 (PERTH); Fowlers Gully in the Wongan Hills, 21 Sep. 1974, *K.F. Kenneally* 2323 (PERTH); SE corner of Pederah Nature Reserve, on Lake Grace-Kalgarin Highway, c. 3 km N of Jilikan Flatrocks road, 32° 35' S, 118° 17' E, 9 November 1995, *A. Lowrie* 1373 (PERTH); Wongan Hills, 10 Oct. 1903, *A. Morrison* 13183 (PERTH); 12 miles [19.2 km] N of Wialki, 4 Oct. 1958, *G.M. Storr s.n.* (PERTH).

*Distribution.* *Stylidium nungarinense* is found inland from *S. caricifolium* around the eastern areas of the wheatbelt, from Wongan Hills south east to Dragon Rocks. (Figure 1)

*Habitat.* Grows in lateritic hills and breakaways associated with *Allocasuarina* scrub.

*Flowering period.* October.

*Conservation status.* Although not a common species it is distributed over a relatively large area with a number of populations on nature reserves.

*Chromosome number.*  $n = 8$  (Coates 1982).

*Affinities.* Closely related to *Stylidium affine* but differs in having 1 leaf per papery sheath.

***Stylidium sejunctum*** Lowrie, Coates & Kenneally, *sp. nov.*

*S. affine* Sond. affini sed foliis angustioribus, 1-2.5 mm latis, plerumque foliis 4 vel 5 per vaginam papyraceam differt.

*Typus:* South-east corner of Pederah Nature Reserve, on Lake Grace-Kalgarin Highway, c. 3 km north of Jilikan Flatrocks Road, Western Australia, 32° 35' S, 118° 17' E, 9 November 1995, *A. Lowrie* 1373 (*holo:* PERTH 04430948; *iso:* MEL).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves mostly in groups of 4 or 5 arising from each basal papery sheath. *Leaves* linear, 16-25 cm long, 1-2.5 mm wide, midrib visible on both the adaxial and abaxial surfaces, margins curved but not revolute, glabrous. *Inflorescences* paniculate, including scape 25-45 cm long, densely glandular-pubescent; peduncles 2-4-flowered, the basal ones 1.5-3 cm long, the upper ones shorter; bracts linear, 3-8 mm long; bracteoles 1.5-2 mm long. *Hypanthium* narrowly ellipsoid at anthesis, 3-6 mm long, 1.5-2.3 mm wide, densely glandular-pubescent. *Sepals* 3.5-4.5 mm long, 3 free to the base, 2 joined for half of their length, glandular-pubescent. *Corolla* pale pink, lobes vertically paired; anterior lobes 9-11 mm long, 4.5-6.5 mm wide; posterior lobes 7-9 mm long, 3.5-5.2 mm wide. *Labellum* ovate, white with margins reddish at the base, c. 1.9 mm long, c. 0.8 mm wide, papillose, with 2 basal subulate appendages; appendages reddish, c. 0.7 mm long, papillose; boss ovate, pale yellow, c. 1.2 mm long, c. 0.8 mm wide, smooth. *Throat appendages* 4; upper 2 wing-like, pink, c. 2.5 mm long; lower 2 narrowly ovate, bifurcate, pink, red-tipped, c. 2.5 mm long, with white papillae. *Gynostemium* 12.5-14.5 mm long. *Capsule* ellipsoid, slightly laterally compressed, 8-10 mm long, 5.5-6.5 mm wide. (Figure 6)

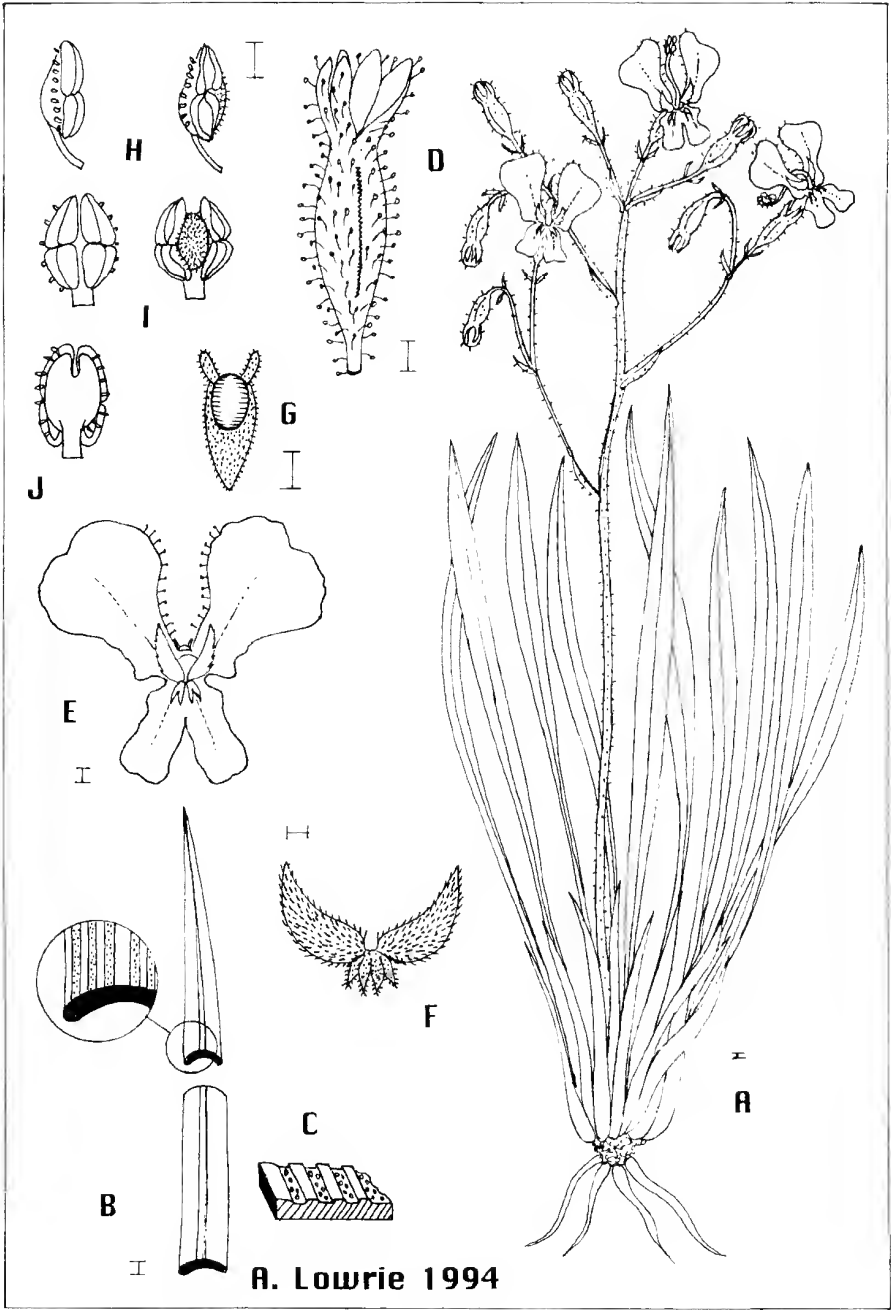


Figure 5. *Stylidium nungarinense* A - habit of flowering plant; B - leaf, enlarged section left; C - part section of the smooth, striate adaxial leaf surface showing the glassy epidermis cells in the longitudinal valleys; D - hypanthium; E - corolla; F - throat appendages; G - labellum; H - lateral view of gynostemium tip (with stigma at right); I - front view of gynostemium tip (with stigma grown out, right); J - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie s.n. 1 Oct. 1988.

*Selected specimens examined.* WESTERN AUSTRALIA: Middle Ironcap, 12 Oct. 1976, *G.J. Keighery* 883 (PERTH); On road from Varley to the junction of Mount Holland-Hatters Hill road, near State barrier fence grid, 32°48'S, 119°31'E, 10 Nov. 1995, *A. Lowrie* 1382 (PERTH).

*Distribution.* The furthest inland species, *Stylidium sejunctum*, occurs on a series of greenstone hills east of Hyden from Mt Holland in the north to Hatter's Hill in the south and is also found to the west, north of Pingaring. *S. sejunctum* and *S. nungarinense* occur in sympatry at the site north of Pingaring. (Figure 1)

*Habitat.* Grows in beige sandy loam or in laterite gravel soils surrounded by thick *Allocasuarina* scrub.

*Flowering period.* October-November.

*Conservation status.* CALM Conservation Codes for Western Australian Flora: this species is generally restricted to the Iron Caps area east of Hyden but is also found in a nature reserve to the south west, therefore Priority Two is appropriate.

*Chromosome number.*  $n = 6$  (Coates 1982).

*Etymology.* The epithet is from the latin *sejunctum* - isolated, in reference to this species being located well inland and separated from the majority of species within the *Stylidium caricifolium* complex.

*Affinities.* Related to *Stylidium affine* but differs in having narrower leaves 1-2.5 mm wide, mostly with 4-5 leaves per papery sheath.

***Stylidium wilroyense*** Lowrie, Coates & Kenneally, *sp. nov.*

*S. caricifolio* Lindl. affini sed foliis ad basim dense lanatis differt.

*Typus:* Wilroy, Western Australia [precise locality withheld], 2 November 1995, *A. Lowrie* 1365 (*holo:* PERTH04430964; *iso:* MEL).

*Perennial herb*, forming a leafy tuft of long erect or recurved leaves singularly arising from each basal papery sheath with a dense woolly covering amongst the leaf bases. *Leaves* lanceolate, 12-15 cm long, 5-6 mm wide midrib visible on both the adaxial and abaxial surfaces, adaxial surface densely scabrid, abaxial surface glabrous, margins slightly curved but not revolute. *Inflorescences* racemose, including scape 42-47 cm long, densely glandular-pubescent; peduncles 1-flowered, the basal ones 15-20 mm long, the upper ones 4-6 mm long; bracts linear, 5-7 mm long; bracteoles 2-3 mm long. *Hypanthium* ellipsoid at anthesis, 6-7 mm long, 3.5-4 mm wide, densely glandular-pubescent. *Sepals* 6.5-7 mm long, free to base, glandular-pubescent. *Corolla* dark pink, lobes vertically paired; anterior lobes 13-15 mm long, 7-9 mm wide; posterior lobes 12-15 mm long, 7-8 mm wide. *Labellum* ovate, dark pink, *c.* 3 mm long, *c.* 1.5 mm wide, papillose, with 2 basal subulate appendages, apex acute; appendages dark pink, *c.* 0.8 mm long, papillose; boss ovate, white, *c.* 2 mm long, *c.* 1 mm wide, smooth. *Throat appendages* 4; upper 2 wing-like, pink, *c.* 1.5 mm long; lower 2 narrowly ovate, bifurcate, with a flat section between, pink, *c.* 1.5 mm long, papillose. *Gynostemium* 19-20.5 mm long. *Capsule* ellipsoid, slightly laterally compressed, 7-8 mm long, 5-6 mm wide. (Figure 7)

*Selected specimens examined.* WESTERN AUSTRALIA: E of Kalbarri, [precise locality withheld], 2 Oct. 1995, *D. Coates* 795 (PERTH); NE of Mingenew [precise locality withheld], 2 Oct. 1992, *A. Carr* 125 (PERTH).

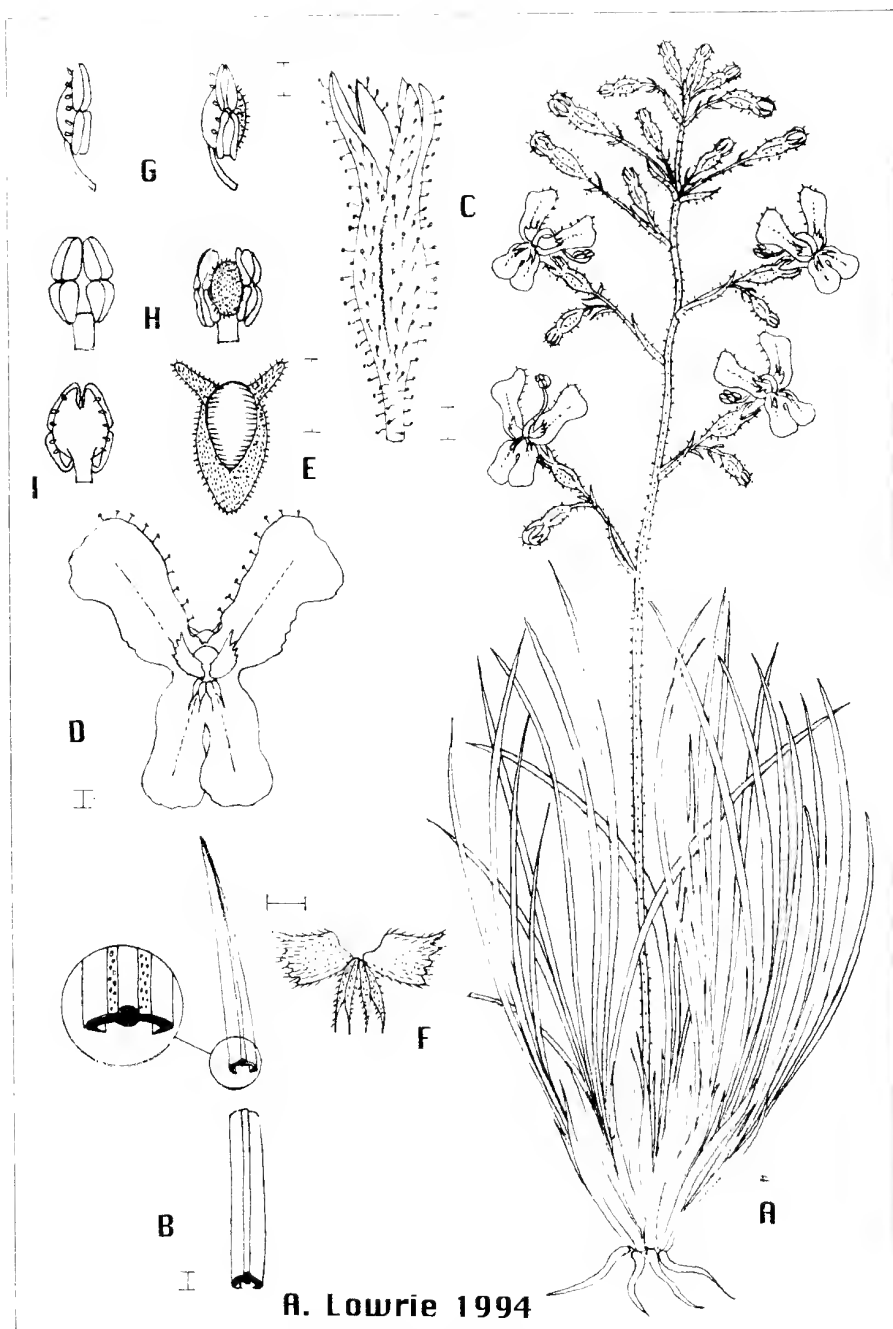


Figure 6. *Stylidium sejunctum*. A - habit of flowering plant; B - leaf, enlarged section left; C - hypanthium; D - corolla; E - labellum; F - throat appendages; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie 1373.

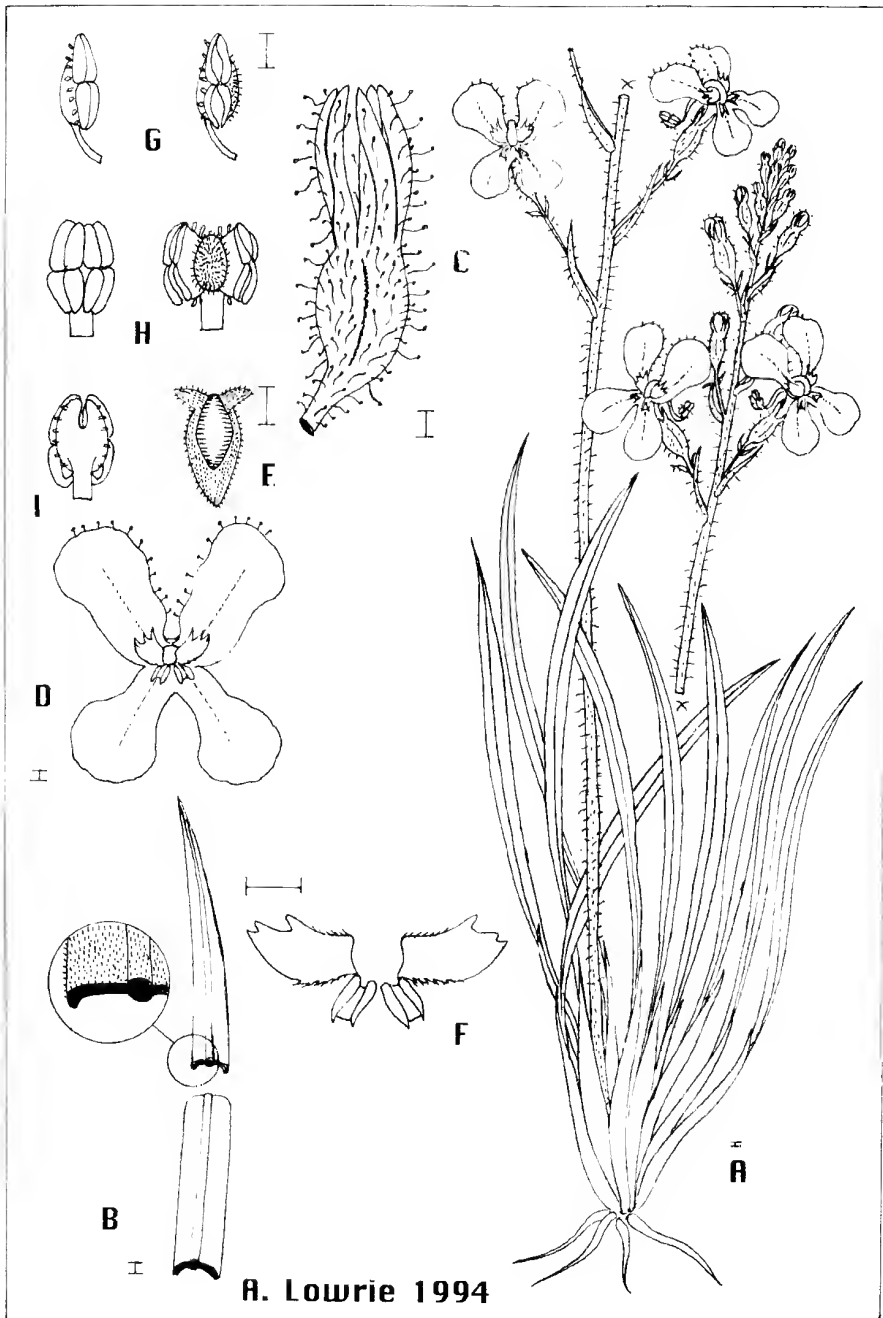


Figure 7. *Stylidium wilroyense* A - habit of flowering plant; B - leaf, enlarged section left; C - hypanthium; D - corolla; E - labellum; F - throat appendages; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium. Scale bar for all = 1 mm. Drawn from A. Lowrie 1365.

*Distribution.* This species is only known from near Wilroy and east of Kalbarri. (Figure 1)

*Habitat.* Grows in light brown sandy loam under 3 m tall *Acacia* species at Wilroy and in yellow sand east of Kalbarri.

*Flowering period.* October.

*Conservation status.* CALM Conservation Codes for Western Australian Flora: Priority One with highest priority for further survey and consideration for gazettal as Declared Rare Flora. Only three localities known, all from a largely cleared area of the north-east wheatbelt.

*Chromosome number.*  $n = 8$  (Coates 1995).

*Etymology.* The epithet, *wilroyense* refers to the Wilroy region in south-west Western Australia where specimens for cytogenetic and allozyme studies were collected.

*Affinities.* Closely related to *Stylidium caricifolium* but differs by having inflorescences racemose, including scape 42-47 cm long; peduncles 1-flowered, the basal ones 15-20 mm long, the upper ones 4-6 mm long, and a dense woolly covering amongst the leaf bases.

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## A taxonomic revision of the genus *Byblis* (Byblidaceae) in northern Australia

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### Abstract

Lowrie, A. and Conran, J.G. A taxonomic revision of the genus *Byblis* (Byblidaceae) in northern Australia. Nuytsia 12(1): 59-74 (1998). The northern Australian species of *Byblis* (Byblidaceae) are revised and illustrated. Two new species, *Byblis aquatica* Lowrie & Conran and *B. rorida* Lowrie & Conran are named. *Byblis liniflora* subsp. *occidentalis* Conran & Lowrie is reduced to a synonym of *B. filifolia* Planch., which is reinstated as a distinct species. Lectotypifications are provided for *B. filifolia* and *B. liniflora* Salisb. A key, table and distribution maps for the four *Byblis* taxa in northern Australia are also presented.

### Introduction

When *Byblis liniflora* subsp. *occidentalis* was described (Conran & Lowrie 1993), the existence of a third taxon, referred to by the manuscript name *B. aff. liniflora* "Darwin", was recorded. This taxon was considered to be an ecotype of *B. liniflora*, growing in wetter conditions than *B. liniflora*, and it was elected to retain *B. aff. liniflora* "Darwin" within *B. liniflora* pending further studies. Meyers-Rice (1993) demonstrated that two taxa, *B. aff. liniflora* "Kununurra" (*B. filifolia*) and *B. aff. liniflora* "Darwin" (*B. aquatica*) were reproductively isolated and Flisek (1996) concluded that *B. aff. liniflora* "Darwin" was sufficiently distinct on morphological grounds to be regarded as a distinct species.

The aim of the current study was to revise the taxonomy of the genus *Byblis* Salisb. (Byblidaceae) in northern Australia by means of a re-examination of the type material and a detailed examination of the morphology and ecology of all members of the plant group.

### Materials and methods

Extensive field studies of the northern *Byblis* taxa were conducted by Allen and Pauline Lowrie in the Kimberley in northern Western Australia and the Northern Territory from 1988 to 1996. Field-collected seeds of *B. aquatica* (A. Lowrie 10, 74, 891, 897, 932, 1117); *B. filifolia* (A. Lowrie 722, 771, 1110, 1399, 1410, 1463); *B. liniflora* (A. Lowrie 951, 1107, 1389, 1413, 1416, 1462); and *B. rorida*

(*A. Lowrie* 1394, 1405, *A. Lowrie & S. Geisen s.n.* 10 Feb. 1995, *R. L. Barrett* 250, 617, 825) were grown in an unheated glasshouse in Perth during the summer from 1989 to 1996.

The early collections of *Byblis aquatica*, *B. filifolia* and *B. liniflora* were cultivated annually from the previous season's hand-pollinated seed. In 1996, *B. rorida* was cultivated for the first time with *B. aquatica*, *B. filifolia* and *B. liniflora* under identical conditions.

Seed was germinated by first soaking the seed in a solution of 10 ml of gibberellic acid to 1000 ml of distilled water for 24 hours. Seed was surface sown onto sphagnum peat moss in 15 cm diam. plastic pots. The pots were watered from below by standing them in a tray holding a 2 cm depth of water. Natural sunlight was provided broken by 30% shade cloth.

Morphological descriptions were drawn up using dried, spirit, fresh and cultivated material. The illustrations were drawn from fresh material.

### Taxonomic treatment

Table 1 compares the morphological characteristics of the four species of *Byblis* in northern Australia. Figure 1 provides a generalized geographical distribution for these species.

Table 1. Morphological comparison of the four species of *Byblis* in northern Australia

	<i>B. aquatica</i>	<i>B. filifolia</i>	<i>B. liniflora</i>	<i>B. rorida</i>
<b>Plants</b>				
height	up to 5 cm <sup>1</sup>	20-60cm	5-15cm	6-30cm
<b>Sepals</b>				
length	3-4 mm	4.5-6.5 mm	3-5.5 mm	3.5-4.5 mm
stalked glands	short	short	short	long
sessile glands	absent	absent	absent	present
<b>Corolla</b>				
adaxial surface	purple	mauve	pinkish mauve	mauve
abaxial surface	purple	white, yellow or yellow with mauve stripes	white	white
<b>Anthers</b>				
length	< filaments	> filaments	< filaments	> filaments
<b>Seeds</b>				
length	1-1.3mm	0.5-0.6mm	0.6-0.8mm	0.7-0.8mm
longitudinal ridges	smooth, prominent	denticulate	minutely denticulate crenulate	minutely denticulate,
transverse ridges	absent	deep	shallow	shallow

<sup>1</sup> stems becoming much longer (up to 45 cm) but then straggling or floating

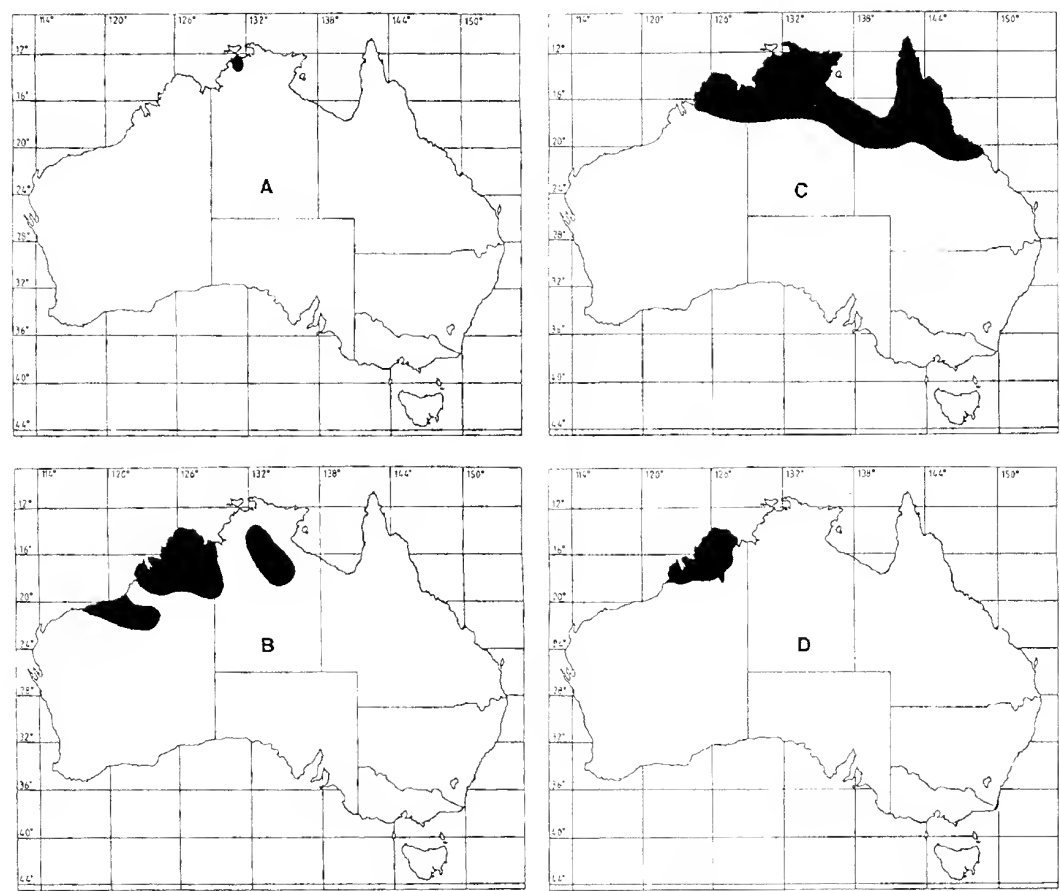


Figure 1. Generalized geographical distribution of *Byblis* in northern Australia A - *Byblis aquatica*; B - *B. filifolia*; C - *B. liniflora*; D - *B. rorida*.

Key to the species of *Byblis* in northern Australia

- 1 Anthers shorter than the filaments ..... 2
- 1: Anthers as long as, or longer than the filaments ..... 3
- 2 Plants erect, bushy; pedicels as long as or longer than the leaves;  
seeds 0.6-0.8 mm long, with minutely denticulate longitudinal ridges  
and shallow transverse ridges between ..... ***B. liniflora***
- 2: Plants elongated, straggling or floating; pedicels as long as or shorter than  
the leaves; seeds 1-1.3 mm long, with smooth, prominent longitudinal ridges  
but no transverse ridges ..... ***B. aquatica***
- 3 Sepals bearing glandular setae 0.7-1.5 mm long; pedicels (especially near  
the apex), sepal bases and apical juvenile leaf growth densely covered  
with sessile glands ..... ***B. rorida***
- 3: Sepals bearing stalked glands 0.3-0.5 mm long; pedicels and apical juvenile  
leaf growth covered with stalked glands ..... ***B. filifolia***

***Byblis aquatica* Lowrie & Conran, *sp. nov.***

*B. liniflorae* Salisb. affinis sed pedicellis folia aequantibus vel eis brevioribus, foliis seeus axem majorem dispersis; axe majore in statu juvenili breviter erecto, demum supra herbas propinquis inclinat, sed in statu maturo ad 45 cm longo supra terram effusos vel in habitationibus inundatis natanti differt.

*Typus:* On Redeliffe Road, c. 1 km north of the junction with Elizabeth Valley Road, Noonamah, Northern Territory, 12°44'S, 131°03'E, 28 April 1995, *A. Lowrie* 1117 (*holo:* PERTH 04658906; *iso:* DNA, MEL).

A fibrous-rooted *annual herb* with leaves scattered along an elongated major axis, up to 5 cm long and erect when juvenile, 5-15 cm long and leaning on nearby herbs when older, 15-45 cm long and straggling over the ground or floating when the habitat floods in the wet season. *Leaves* terete, tapering towards a small apical knob-like swelling, 2-4 cm (mostly 3-3.5 cm) long, greenish maroon, covered with numerous viscid, stalked insectivorous glands. *Inflorescence* of solitary axillary flowers, many-flowered but few flowers open at the same time. *Pedicels* 1.5-3 cm (mostly 2-2.5 cm) long. *Sepals* ovate, 3-4 mm long, 1.2-1.5 mm wide, glands stalked, almost glabrous. *Petals* obovate, adaxial and abaxial surface purple, 5-7 mm long, 2.5-4.5 mm wide, margins entire, apex erenate. *Stamens* 5, filaments 2-2.5 mm long, anthers 0.9-1.3 mm long. *Ovary* 0.8-1 mm long, with a few glands on the apex at anthesis. *Style* 2-2.5 mm long; stigma with numerous papillae. *Capsule* broadly obovoid, 3-4 mm long, 2.5-4 mm wide. *Seeds* 1-1.3 mm long, black, with smooth, prominent longitudinal ridges but no transverse ridges. (Figure 2)

*Other specimens examined.* NORTHERN TERRITORY: Howard River, 3 Apr. 1988, *A. Lowrie* 10 (PERTH); near "Dry Dump", Elrundie Road, Palmerston, 14 Apr. 1990, *A. Lowrie* 74 (PERTH); 1.6 km SE of Chung Wah Terrace, on Elrundie Road, Palmerston, 23 Apr. 1994, *A. Lowrie* 891 (PERTH); Gunn Point Road, c. 1 km northwards of Howard River Bridge, Howard Springs, 24 Apr. 1994, *A. Lowrie* 897 (PERTH); on Hopewell Road, 1 km from Berry Springs, 27 Apr. 1994, *A. Lowrie* 932 (PERTH); Noonamah pumping station, 7 Jan. 1991, *P. Simmons* 14 (PERTH); 17.7 km from Berry Springs along Cox Peninsular Road heading to Mandorah, 31 Mar. 1991, *P. Simmons s.n.* (PERTH).

*Distribution.* *Byblis aquatica* is distributed from Darwin to Berry Springs in the Northern Territory.

*Habitat.* *Byblis aquatica* grows in fine clayey sand in wet season-flooded depressions and on the shores of freshwater lagoons in shallow water.

*Flowering period.* January to May.

*Conservation status.* *Byblis aquatica* is a common species in the Northern Territory and is currently not under threat.

*Etymology.* The epithet, *aquatica*, is taken from the Latin, *aquaticus* - growing in water.

*Affinities.* In the Darwin region *Byblis aquatica* and *B. liniflora* are often found near each other, but always in different habitat niches. In the case of *B. aquatica* the habitat is always flooded to a shallow depth in the wet season, whereas *B. liniflora* is restricted to the nearby higher, well drained soils.

*Byblis aquatica* has the following features that differ from those of *B. liniflora*, the contrasting features of the latter being given in parentheses: flowers purple (flowers pinkish mauve); leaves greenish

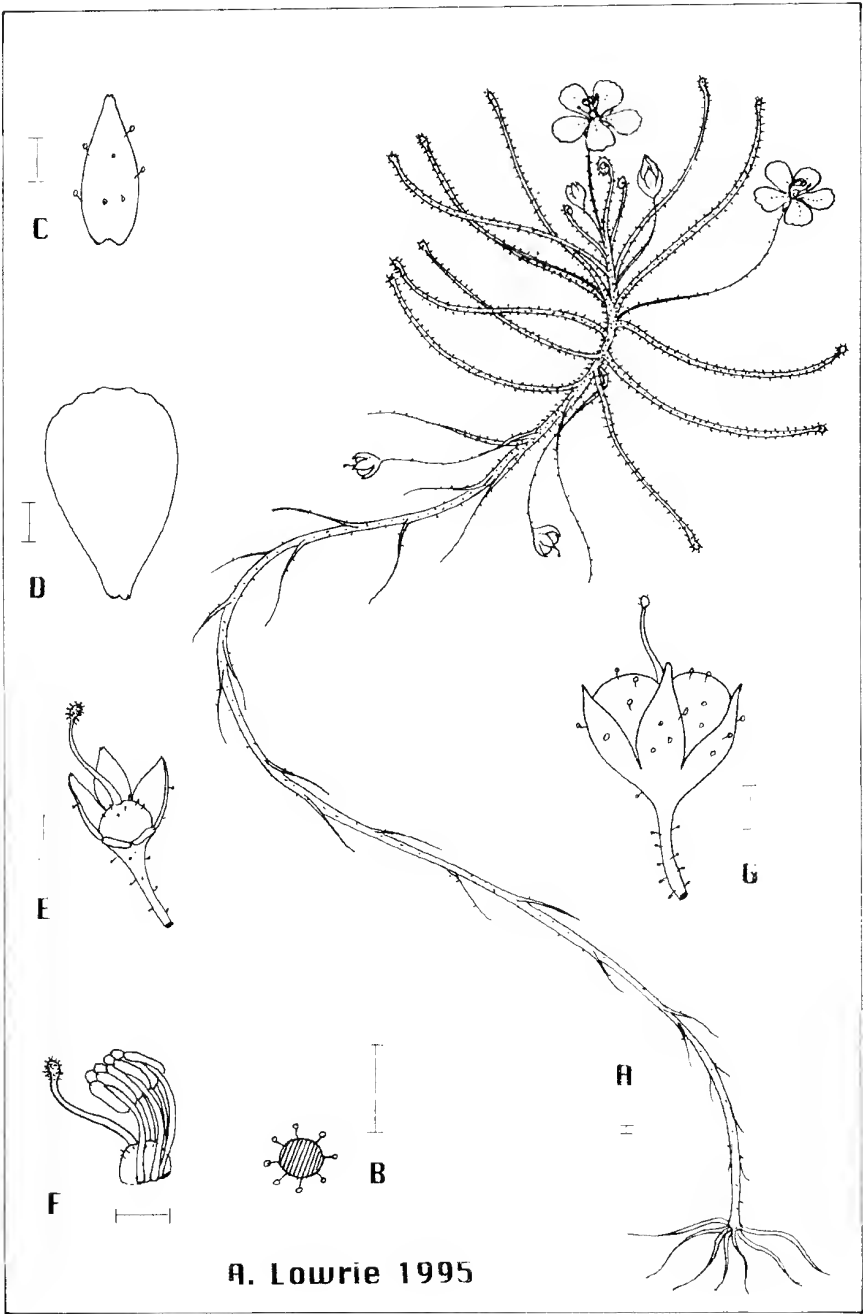


Figure 2. *Byblis aquatica* A - habit of plant in flower; B - leaf section; C - sepal; D - petal; E - gynoecium; F - stamens and gynoecium; G - seed capsule. Scale bar for all = 1 mm. Drawn from A. Lowrie 1117.

maroon (leaves pale green); plants in the beginning shortly erect and self-supported when juvenile up to 5 cm long, erect, but leaning on nearby herbs when older and 5-15 cm long, later straggling over the soil surface or floating when the habitat is flooded in the wet season and 15-45 cm long with the apex of the plant erect from the horizontally positioned major axis and free of the soil or water surface (plants terrestrial, bush-like).

***Byblis filifolia*** Planch. (Planchon 1848: 305-306). *Type*: North west coast of New Holland [Australia], no date, *Bynoe s.n.* in Herb. Hook. (*lecto*, here designated: K); single specimen on shared sheet, labelled "*B. filifolia* N. W. Coast, Australia, no date, *Bynoe s.n.*" in Herb. Hook. (*isolecto*: K).

***Byblis liniflora* subsp. *occidentalis*** Conran & Lowrie (Conran & Lowrie 1993: 175-179). *Type*: Vansittart Bay, unnamed creek running into Pauline Bay, mouth of creek above tidal influence, Western Australia, 22 May 1984, *S.J. Forbes* 2095 (*holo*: PERTH 01490281 (specimen on right); *iso*: PERTH (specimen on left), MEL, L).

A fibrous rooted *annual herb* with leaves scattered along a rather woody major axis, plants erect or leaning on nearby herbs for support 20-60 cm in height. *Leaves* terete, tapering towards a small apical knob-like swelling, 3-15 cm (mostly 4-8 cm) long, covered with numerous viscid, stalked insectivorous glands. *Inflorescence* of solitary axillary flowers, many-flowered, apical clusters of many open flowers are produced at the peak of anthesis. *Pedicels* 3-10 cm (mostly 4-7 cm) long. *Sepals* obcnate or lanceolate, 4.5-6.5 mm long, 1.2-1.8 mm wide, surface and margins densely glandular. *Petals* obovate, mauve, abaxial surface white, yellow or yellow with mauve radiating stripes, 10-15 mm long, 9-10 mm wide, margins entire, apex irregularly serrate. *Stamens* 5, filaments 1-3 mm long, anthers 2.5-3.5 mm long. *Ovary* 1.2-1.5 mm long, densely glandular on the apex at anthesis. *Style* 4.5-5.5 mm long, apex with numerous papillae. *Capsule* broadly obovoid, 3.5-4.5 mm long, 4.5-5 mm wide. *Seeds* 0.5-0.6 mm long, with denticulate longitudinal ridges and deep transverse ridges between. (Figure 3)

*Other specimens examined*. WESTERN AUSTRALIA: De Grey River, 1940, *N.T. Burbidge* 1006 (PERTH); c. 5 km W of Beverley Springs Homestead, 12 Aug. 1975, *A.S. George* 12237 (PERTH); Weaber Plains Road, 1 Apr. 1988, *A. Lowrie* 6 (PERTH); Gibb River road, Dawn Creek crossing, 18 June 1993, *A. Lowrie* 722 (PERTH); Gibb River road, Russ Creek crossing, 25 June 1993, *A. Lowrie* 771 (PERTH); 2 km N of the King Edward River crossing, Kimberley, 23 June 1994, *A. Lowrie* 970 (PERTH); 3.5 km SE of Honeymoon Beach, NW of Kalumburu, 26 June 1994, *A. Lowrie* 1006 (PERTH); Dominic Creek on the road to Pago Mission, 26 June 1994, *A. Lowrie* 1008 (PERTH); Unamon Creek on the road to Pago Mission, 26 June 1994, *A. Lowrie* 1020 (PERTH); On Gibb River-Kununurra road at Rolly's Jumpup, Durack River Station, 28 June 1994, *A. Lowrie* 1040 (PERTH); 15 km W of Kununurra, 26 Apr. 1995, *A. Lowrie* 1110 (PERTH); King Edward River crossing, Kimberley, 26 Apr. 1996, *A. Lowrie* 1399 (PERTH); c. 0.5 km W of Little Merten's Creek Helipad, 28 Apr. 1996, *A. Lowrie* 1410 (PERTH); 45.4 km E of Kununurra, 8 May 1996, *A. Lowrie* 1463 (PERTH); c. 1 km N of Taylor's lagoon, 26 June 1997, *A. Lowrie* 1698 (PERTH); 6.2 km W of Taylor's Lagoon, 26 June 1997, *A. Lowrie* 1704 (PERTH); Miangii, E side of Vansittart Bay, Kimberley, 25 Mar. 1993, *A.A. Mitchell* 2922 (PERTH); Port Hedland airport, 28 June 1969, *H. van Dam* 122 (AD, PERTH).

NORTHERN TERRITORY: Near watercourse 44 km SW of Hooker Creek settlement, 15 Apr. 1959, *G. Chippendale s.n.* (PERTH); Woolanang, 4 Apr. 1981, *C.R. Dunlop & L. Craven* 5923 (PERTH); 147 mile [235.2 km] peg, Stuart Highway, 4 Apr. 1965, *A.S. George* 6517 (PERTH); Cox River Station, 9 Aug. 1977, *T.S. Henshall* 1672 (PERTH).

*Distribution*. *Byblis filifolia* is distributed from the Port Hedland region to the Little Sandy Desert and Great Sandy Desert; throughout the Kimberley in Western Australia and adjoining regions in Northern Territory; and south-west of the Katherine region towards the Tanami Desert.

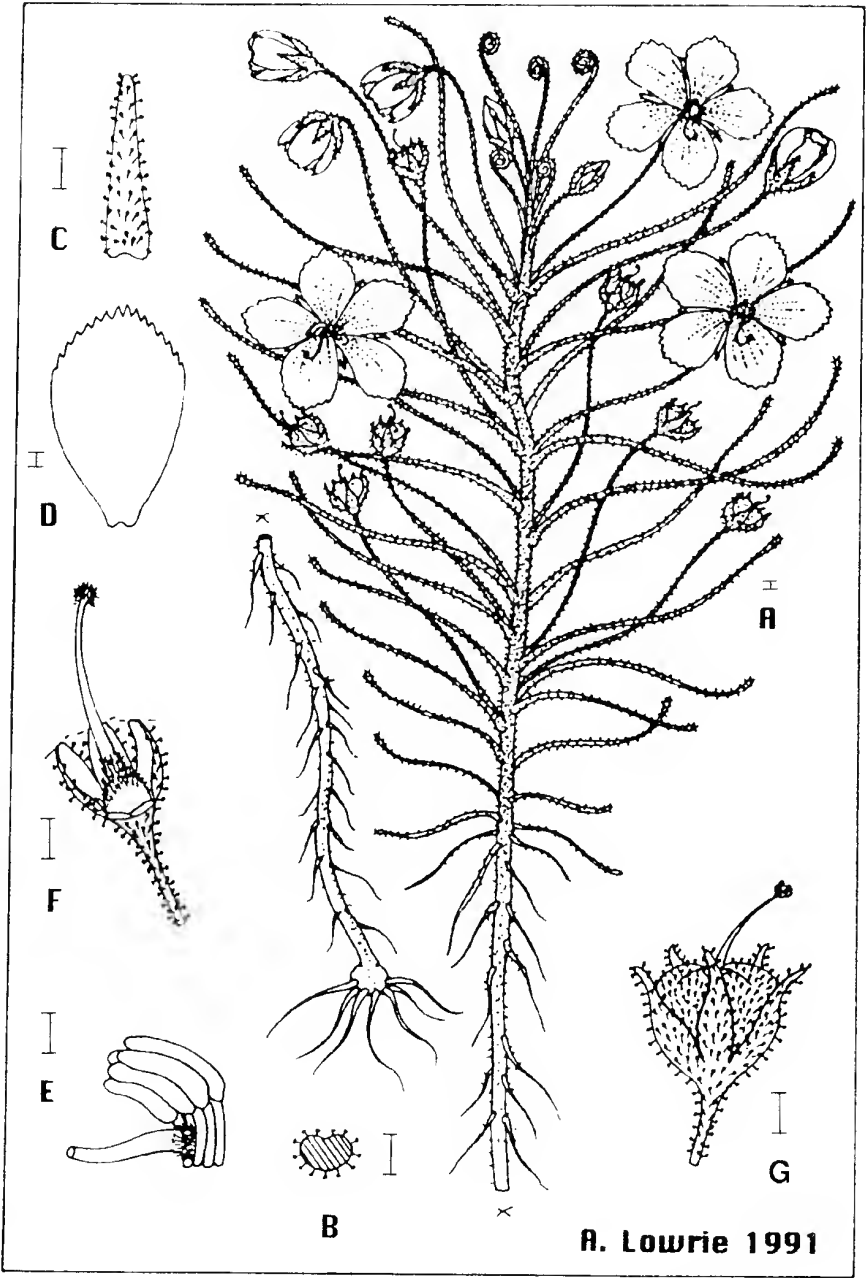


Figure 3. *Byblis filifolia* A - habit of plant in flower; B - leaf section; C - sepal; D - petal; E - stamens and gynoecium; F - gynoecium; G - seed capsule. Scale bar for all = 1 mm. Drawn from A. Lowrie 6.

*Habitat.* *Byblis filifolia* grows in sandy soils in savannah woodland, in sandy soils on river and creek margins, fresh water seepage areas, watersheds in sandy loam and in skeletal soils over sandstone pavements.

*Flowering period.* March to June.

*Affinities.* *Byblis filifolia* can be readily distinguished from *B. aquatica* and *B. liniflora* by its anthers as long as, or longer than the filaments and from *B. rorida* by having plants erect or leaning on nearby herbs for support and 20-60 cm in height; densely glandular sepals; and by the lack of sessile glands on the pedicels, sepal bases and apical juvenile leaf growth.

*Conservation status.* *Byblis filifolia* is a common species throughout the Kimberley region of northern Western Australia and not under threat.

*Etymology.* The epithet, *filifolia*, is taken from the Latin, *filum* - thread, and *folium* - leaf, describing the filiform leaves, especially in pressed specimens of this species (Sharr 1996).

*Lectotypification.* The lectotype consists of four specimens 12.9 cm tall, near the top on their own sheet. The isotype is a single specimen of a similar height, labelled *Byblis filifolia* from the same collection of Bynoe on a shared sheet with "*B. liniflora*, Gulf of Carpentaria (remaining hand written notes unclear)" and "*B. filifolia*, Sturt's Creek, F. Mueller."

*Notes.* Examination of the Cibachrome photographs of the type specimens of *Byblis caerulea* and *B. filifolia* indicated both taxa should be placed in synonymy under *B. liniflora* Salisb. because of their small size and stature which closely resembled both the type description and illustration for *B. liniflora* (Conran & Lowrie 1993). However, subsequent detailed examination of the type material of *B. filifolia* (including the stamens hidden by the petals in the Cibachrome photographs) provided convincing evidence that *B. filifolia* is referable to *B. liniflora* subsp. *occidentalis*. Complete stamens with anthers 3 mm long and filaments 1 mm long were observed on two of the five specimens of the Bynoe sheets. The remaining three specimens were in fruit. The key character (anthers as long as, or longer than the filaments), separates *B. filifolia* from *B. liniflora*. The *B. caerulea* type sheet copy (BM) as well as examination of specimens labelled *B. caerulea* at (K) confirmed that *B. caerulea* should remain as a synonym under *B. liniflora* Salisb.

There are also three specimens labelled "*Byblis filifolia* Pl. Sturt's Creek, F. Mueller" (located at the bottom of the herbarium sheet with the single Bynoe specimen of *B. filifolia* above). The stamens of these Mueller specimens also possess anthers that are longer than the filaments, similar to the *B. filifolia* Bynoe collection. No precise location details are given, but Sturt's Creek is located in the arid inland region of east Kimberley, Western Australia and the adjoining region in Northern Territory bordering the Tanami Desert.

Benjamin Bynoe was the ship's surgeon and naturalist on *H.M.S Beagle* (which on another voyage carried Charles Darwin around the world) undertaking maritime surveys for The British Hydrographic Office under the command of John Lort Stokes 1837-1843 (Hordern 1989). The five specimen collection of *Byblis filifolia* labelled "N.W. Coast, New Holland, Bynoe" was collected from the tropical north-west coast region of Australia, now known as the Kimberley, somewhere between Roebuck Bay and the Prince Regent River. *H.M.S. Beagle's* surveying grounds in the Kimberley were reached by sailing from the Swan River in south-west Western Australia, to which they later returned, from January to May 1838 (the wet season in northern Australia).



Exactly where Bynoe collected his specimens on the north-west coast is not recorded, however, *Byblis* is common in freshwater seepage areas, watersheds, creek and river margins throughout the Kimberley, including coastal regions. Bynoe could have collected his specimens from any of a multitude of suitable freshwater habitats (in the wet season) just above the high tide shoreline between Roebuck Bay and Prince Regent River along the north west coastal regions of the Kimberley. Additionally, he undertook many short explorations inland in the Kimberley region to hunt and collect natural history specimens.

In April 1995 *Byblis filifolia* (A. Lowrie 1110 PERTH) was discovered coexisting with *B. liniflora* (A. Lowrie 1107 PERTH) at a newly explored location 15 km west of Kununurra, Western Australia. The habitat consists of sandy loam soil covered in most parts by a film of water (at the end of the wet season) which supports a low open sedge field along with the other carnivorous plants *Utricularia chrysantha* R. Br., *Utricularia tridactyla* P. Taylor and *Drosera indica* L. Both *Byblis* taxa occurred in reasonable numbers scattered throughout the habitat, and in a few areas within this wet habitat the two species were observed growing side by side. In this area, *B. liniflora* was confined to the wetter ground; *B. filifolia* also grew on the surrounding higher, well-drained sandy soils in association with *Drosera ordensis* Lowrie.

In this habitat, the two *Byblis* taxa clearly differ from each other. Specimens of *B. filifolia* are large robust plants 20-60 cm tall, whereas specimens of *B. liniflora* are small plants 5-15 cm tall. As well as the overall size difference between both taxa, the key morphological character of *B. filifolia* bearing anthers as long as, or longer than the filaments and *B. liniflora* bearing anthers shorter than the filaments held true with all specimens examined throughout the habitat. A thorough search was made of the entire location paying particular attention to establishing if intermediate forms existed between both species. Despite extensive exploration of the habitat over two days, no intermediate forms were found. In May 1996, 45.4 km east of Kununurra *B. filifolia* (A. Lowrie 1463 PERTH) was again found growing with *B. liniflora* (A. Lowrie 1462 PERTH) in a similar habitat. At this location the two taxa maintained their distinctive maximum height differences. These two observations at widely separated locations confirm that *B. filifolia* and *B. liniflora* can coexist with each other without apparently hybridizing, providing further justification to treat both taxa as distinct entities.

In a study conducted by Meyers-Rice (1993), the failure of *Byblis filifolia* to produce seed when crossed with *B. aquatica*, indicated reproductive isolation. The author concluded that *B. aquatica* and *B. filifolia* are different species and recommended that they be formally described.

***Byblis liniflora*** Salisb. (Salisbury & Hooker 1808: t. 95). - *Psyche liniflora* Salisb. *nom. inval.* (Salisbury & Hooker *loc. cit.*). *Type:* Illustration tab. 95 in Salisbury & Hooker (*loc. cit.*) as *Psyche liniflora*.

***Byblis caerulea*** R. Br. ex Planch. (Planchon 1848: 306). *Type:* Australia: Endeavour River, [Queensland, 1770], Banks & Solander *s.n.* (*holo:* BM).

A fibrous rooted *annual herb* with leaves scattered along the major axis forming an erect bush-like plant 5-15 cm in height. *Leaves* terete, tapering towards a small apical knob-like swelling, 2-8 cm (mostly 3-5 cm) long, covered with numerous viscid, stalked insectivorous glands. *Inflorescence* of solitary axillary flowers, many-flowered but few flowers open at the same time. *Pedicels* 3-9 cm (mostly 4-6 cm) long. *Sepals* lanceolate, 3-3.5 mm long, 1-1.3 mm wide, surface and margins moderately glandular. *Petals* obovate, pinkish mauve, abaxial surface white, 5-8 mm long, 3-4 mm wide, margins entire, apex crenate. *Stamens* 5, filaments 2-2.5 mm long, anthers 1-1.5 mm long. *Ovary* 0.9-1.2 mm long, with a few glands

on the apex at anthesis. *Style* 2.5-3.5 mm long, apex with numerous papillae. *Capsule* broadly obovoid, 2.5-4 mm long, 4.5-6 mm wide. *Seeds* 0.6-0.8 mm long, with minutely denticulate longitudinal ridges and shallow transverse ridges between, producing honeycomb-like sculpturing. (Figure 4)

*Other specimens examined.* WESTERN AUSTRALIA: 15 km W of Kununurra, 26 Apr. 1995, *A. Lowrie* 1107 (PERTH); 16.1 km W of Kununurra, 18 Apr. 1996, *A. Lowrie* 1389 (PERTH); Mitchell Falls walk trail, Kimberley, 28 Apr. 1996, *A. Lowrie* 1413 (PERTH); Above Little Merten's Falls, Kimberley, 28 Apr. 1996, *A. Lowrie* 1416 (PERTH); On coast c. 15 km W of Mount Anderdon, Kimberley [helicopter collection], 2 May 1996, *A. Lowrie* 1432 (PERTH); Summit of Mount Trafalgar, Kimberley [helicopter collection], 2 May 1996, *A. Lowrie* 1433 (PERTH); 5.1 km E of Kununurra, 8 May 1996, *A. Lowrie* 1461 (PERTH); 45.4 km E of Kununurra, 8 May 1996, *A. Lowrie* 1462 (PERTH); Just outside Kununurra meat works, 4 Mar. 1993, *A. A. Mitchell* 2849 (PERTH, BROOME); Beverley Springs homestead, Kimberley, 19-26 May 1979, *B. G. Muir et al.* 796B (sheet 2/2 PERTH 01490249)\*.

NORTHERN TERRITORY: Send of Owston Ave, Palmerston, 8 Apr. 1990, *A. Lowrie* 48 (PERTH); Near "Dry Dump" Elrundie Road, Palmerston, 14 Apr. 1990, *A. Lowrie* 75 (PERTH); Berrimah Road, 3.5 km W of Stuart Highway, Darwin, 29 Apr. 1994, *A. Lowrie* 951 (PERTH); Owston Ave, Palmerston, 9 Mar. 1991, *P. Simmons s.n.* (PERTH).

QUEENSLAND: c. 10 miles [16 km] N of Kennedy, 15 May 1973, *R. Nash* 1382 (PERTH); Upper Murray River turn off (N road) from Highway 1, 21 Aug. 1983, *R. Nash* 1824 (PERTH); At southern turn off to Upper Murray River, north Cardwell, on Highway 1, 21 Aug. 1983, *R. Nash* 1857 (PERTH).

*Distribution.* *Byblis liniflora* is widespread throughout the northern regions of Western Australia, Northern Territory and Queensland.

*Habitat.* *Byblis liniflora* grows in sandy soils, clayey sand and in skeletal soils over sandstone pavements.

*Flowering period.* March to August.

*Conservation status.* *Byblis liniflora* is a common species throughout northern Australia and not under threat.

*Etymology.* The epithet, *liniflora*, is taken from the Latin, *linum* - flax, and *floris* - flower (Sharr 1996).

*Affinities.* *Byblis liniflora* can be readily distinguished from *B. filifolia* and *B. rorida* by its anthers shorter than the filaments and from *B. aquatica* by its terrestrial bush-like plant habit, pinkish mauve flowers, pedicels as long or longer than the leaves and moderately glandular sepals.

*Notes.* The description for *Byblis liniflora* by Salisbury and the illustration by Hooker (Salisbury & Hooker 1808) were based on cultivated material from the collection at Cassiobury, in Hertfordshire. Arthur Capel, first Earl of Essex, had a noted seventeenth-century garden here which at the time was reported by Salisbury to contain some of the finest New Holland (Australian) plants in England. Cassiobury could only have been supplied with seed material of *B. liniflora* as the species is an annual. It is recorded that A. Gordon, a London nurseryman, obtained the original material of *Byblis liniflora* from the then colony of New South Wales which at the time included Queensland.

\* Reassignment of a collection previously filed with *B.G. Muir et al.* 796A and cited in Conran & Lowrie (1993).

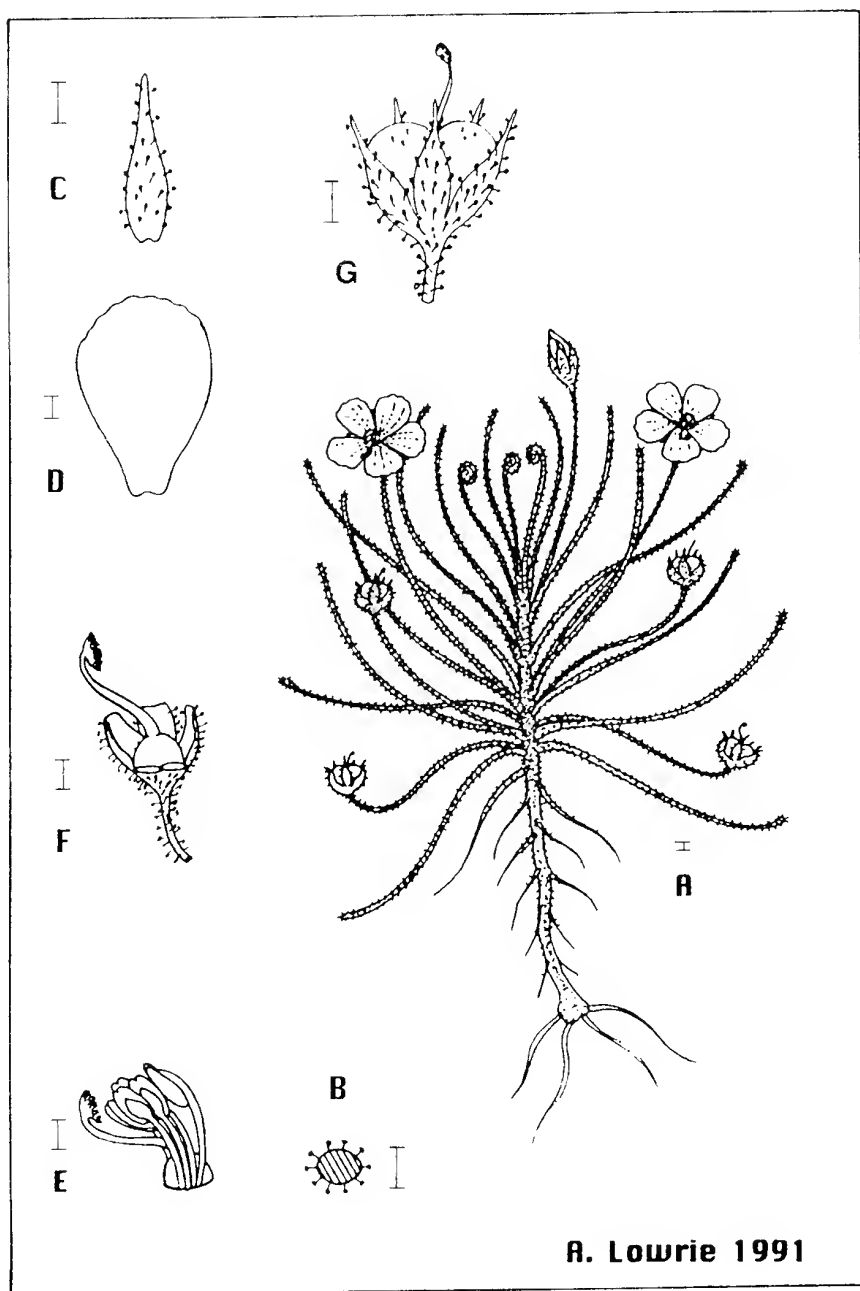


Figure 4. *Byblis liniflora* A - habit of plant in flower; B - leaf section; C - sepal; D - petal; E - stamens and gynoecium; F - gynoecium; G - seed capsule. Scale bar for all = 1 mm. Drawn from A. Lowrie 75.

Although the original description of *Byblis liniflora* by Richard Anthony Salisbury recorded the common name for the species as the “Flax-flowered *Psyche*” and the accompanying illustration by William Hooker (1779-1832) the artist and pupil of Bauer (not to be confused with William Jackson Hooker (1785-1865)), is also labelled *Psyche liniflora*, the name *Psyche*, has not been taken up by other authors. Farr *et al.* (1979) listed *Psyche* as an accepted name although it is not validly published as it was not accepted by the author in its original publication (see Article 34.1 in the International Code of Botanical Nomenclature (Greuter *et al.* 1994)).

*Byblis caerulea* is based on Bauer’s plate 113 published by Endlicher (1841) and drawn from Robert Brown specimens in which the short anthers are figured as being peltate. Planchon (1848) thought he recognized these anthers in the specimens glued down in the Banksian Herbarium [BM]. According to Bentham (1864) the specimens in Brown’s own herbarium showed that this was a mistake as the anthers are often as short as figured by Bauer, sometimes as long as figured by Salisbury & Hooker (1808), but always attached by the base and varying much in intermediate lengths in different specimens.

Bentham’s description of *Byblis liniflora* recorded “anthers varying from  $\frac{3}{4}$  line [1.575 mm] to  $1\frac{1}{2}$  lines [3.15 mm] in length, the filaments longest where the anthers are shortest”. The latter statement corresponds with the key morphological character for *B. liniflora* “anthers shorter than the filaments”. However, anthers 3.15 mm long are not applicable to *B. liniflora* but do agree with *B. filifolia*. Two collections of *B. filifolia*, N.W. coast, *Bynoe* and Sturt’s Creek *F. Mueller*, were cited in Bentham’s *B. liniflora* treatment. Examination of these collections has revealed anthers 3 mm long, comparable to Bentham’s measurements.

The type sheet of *Byblis caerulea* (BM) holds nine specimens. All specimens agree with the original description and illustration for *B. liniflora*. This collection was made on Cook’s First Voyage 1768-1771 from the Endeavour River region, Queensland, Australia, by Banks and Solander, while repairs to the ship *Endeavour* were being made near the present town of Cooktown, from 17 June to 4 August 1770 (Stearn 1969).

There are two herbarium sheets at Kew with early collections referable to *Byblis caerulea*. The first sheet, *R. Brown* 4836, North Coast of New Holland, 1803, has two collections, the first of six specimens and the second of two specimens labelled “Upper Victoria River, F. Mueller”. The second sheet has one collection of eleven plants labelled North Coast of New Holland, 1803. All plants on both sheets match *B. liniflora*.

***Byblis rorida* Lowrie & Conran, *sp. nov.***

*B. filifoliae* Planch. affinis sed sepalis setis longis capitulis glandularibus 0.7-1.5 mm longis ornatis; pedicelis (praecipue prope apicem), sepalis ad basim, et foliis juvenilibus glandulis roscidis dense ornatis; semina cristis minute denticulatis profunde sculptis, costis humilibus reticulatis alternantibus.

*Typus:* 200 metres south-south-east of Beverley Springs Station homestead, Kimberley, Western Australia, 16° 43' 05" S, 125° 27' 32" E, 8 February 1996, *R.L. Barrett* 825 (*holo:* PERTH 04658892; *iso:* DNA, MEL).

A fibrous rooted *annual herb* with leaves scattered along the major axis which is erect or when taller plants leaning on nearby herbs for support, major axis 6-30 cm long with dew-like sessile glands densely covering the juvenile apical growth. *Leaves* terete, tapering towards a small apical knob-like swelling,

2-5 cm long, covered with viscid, sessile glands and stalked insectivorous glands. *Inflorescence* of solitary axillary flowers, many-flowered but few flowers open at the same time. *Pedicels* (especially near the apex) covered with dew-like sessile glands. *Sepals* lanceolate, 3.5-4.5 mm long, 1.2-1.3 mm wide, bearing long setae with glandular heads 0.7-1.5 mm long as well as dew-like sessile glands. *Petals* obovate, mauve, abaxial surface white, 6.5-10 mm long, 4-4.5 mm wide, margins entire, apex deeply dentate. *Stamens* 5, filaments 1-1.5 mm long, 3 anthers 2.5-3 mm long, remaining pair 1.5-2.5 mm long. *Ovary* 0.8-1 mm long, with many stud-like glands on the apex at anthesis. *Style* 4-4.5 mm long, apex bilobed with numerous papillae. *Capsule* broadly obovoid, 3.5-4 mm long, 4-5 mm wide. *Seeds* 0.7-0.8 mm long, black, deeply sculptured and honeycomb-like with minutely denticulate longitudinal crenulate ridges with shallow ridges between. (Figure 5)

*Other specimens examined.* WESTERN AUSTRALIA: Near Beverley Springs Station homestead, 13 Mar. 1993, *R.L. Barrett* 236, 12 Apr. 1995, *R.L. Barrett* 250 (PERTH); 1 km ENE of Beverley Springs Station homestead, 9 Apr. 1995, *R.L. Barrett* 617 (PERTH); 1 km NE of Beverley Springs Station homestead, Kimberley, 10 Feb. 1996, *R.L. Barrett* 839 (PERTH); Wolf Creek [meteor] Crater, c. 85 km S of Halls Creek, 13 July 1974, *G.W. Carr* 3582 & *A.C. Beaughole* 47360 (PERTH)\*; Mitchell Plateau mining camp, 2 Mar. 1980, *C.R. Dunlop* 5348 (BRI, CANB, DNA, PERTH)\*; Yeeda, 28 miles [44.8 km] S E of Derby, Apr. 1927, *A.J. Ewart s.n.* (PERTH); Near Christmas Creek, Kimberley, May 1927, *A.J. Ewart s.n.* (PERTH); Inglis Gap, King Leopold Ranges, May 1905, *W.V. Fitzgerald s.n.* (PERTH); Above Roebuck Bay, May 1960, *C.A. Gardner* 1241 1/3 (PERTH)\*; 11.9 km W of Inglis Gap on Derby to Gibb River road, King Leopold Range, 16 May 1988, *E.M. Goble-Garratt* 591 (PERTH)\*; Great Sandy Desert, 10 km S of Jeffries Field, 4 June 1981, *W.K. Harris* 2 (AD, PERTH)\*; 4 km S of Cape Bertholet, Dampierland, N of Broome, 20 Apr. 1977, *K.F. Kenneally* 6058 (PERTH)\*; Elgee Cliffs Plateau, 17 km W S W of El Questro Homestead, NE Kimberley, 24 Mar. 1978, *M. Lazarides* 8701 (PERTH)\*; Cockman Range, 46 km S S W of Wyndam, NE Kimberley, 16 Mar. 1978, *M. Lazarides* 8574 (PERTH); 39.7 km W of King Edward River crossing on road to Mitchell Falls, 27 Apr. 1996, *A. Lowrie* 1405 (PERTH); Broome Bird Observatory, Kimberley, 25 June 1997, *A. Lowrie* 1693 (PERTH); S side of Taylor's Lagoon, Kimberley, 26 June 1997, *A. Lowrie* 1699 (PERTH); Lake Champion, Kimberley, 10 Feb. 1995, *A. Lowrie* & *S. Geisen s.n.* (PERTH); c. 1 km N of Durack River crossing from Gibb River Road, 23 Apr. 1996, *A. Lowrie* 1394 (PERTH); 9 km SSE of Beverley Springs homestead, 19-26 May 1979, *B.G. Muir et al.* 796 (sheet 1/2 PERTH 01490230)\*; Between Derby and Inglis Gap in King Leopold Range on beef road, May 1967, *Y. Power s.n.* (PERTH)\*; 11 miles [17.6 km] N of Broome, 25 May 1967, *E.M. Scrymgeour* 1930 (PERTH)\*; NE slope of Mount Broome, 30 km on Millewinde road from Gibb River road, King Leopold Ranges, 20 Apr. 1988, *B.K. Simon* & *M. Sands* 4009 (BRI, PERTH); 12 miles [19.2 km] from Gibb River turn off and 11 miles [17.6 km] from turn off to Broome-Fitzroy Crossing, 8 Apr. 1980, *D.E. Symon* 12049 (PERTH)\*; Township of Koolan Island, W Kimberley, 1 Apr. 1984, *L. Vernon* 31 (PERTH).

*Distribution.* *Byblis rorida* is known from scattered locations throughout the Kimberley in Western Australia from the Broome Dampierland region, throughout the King Leopold Range and Beverley Springs a further 300 km north east, at the Cockburn Range and adjoining El Questro to the Durack River 450 km further northwards, 170 km further north west on the Mitchell Plateau, 70 km south of Halls Creek at Wolf Creek Crater on the edge of the Tanami Desert and Koolan Island 130 km north of Derby.

*Habitat.* *Byblis rorida* grows in beige fine grain sand on the margins of Lake Champion, in red sand in *Acacia* woodland and in yellow sand beside creeks in the Broome region; in wet clayey sand and gravel high on creek banks as well as wet season-flooded sandy skeletal soils over sandstone outcrops and pavements with *Triodia pungens* in the Beverley Springs region; laterite soils on the Mitchell Plateau;

\* Reassignment of specimens cited in Conran & Lowrie (1993) as *B. liniflora* subsp. *occidentalis*.

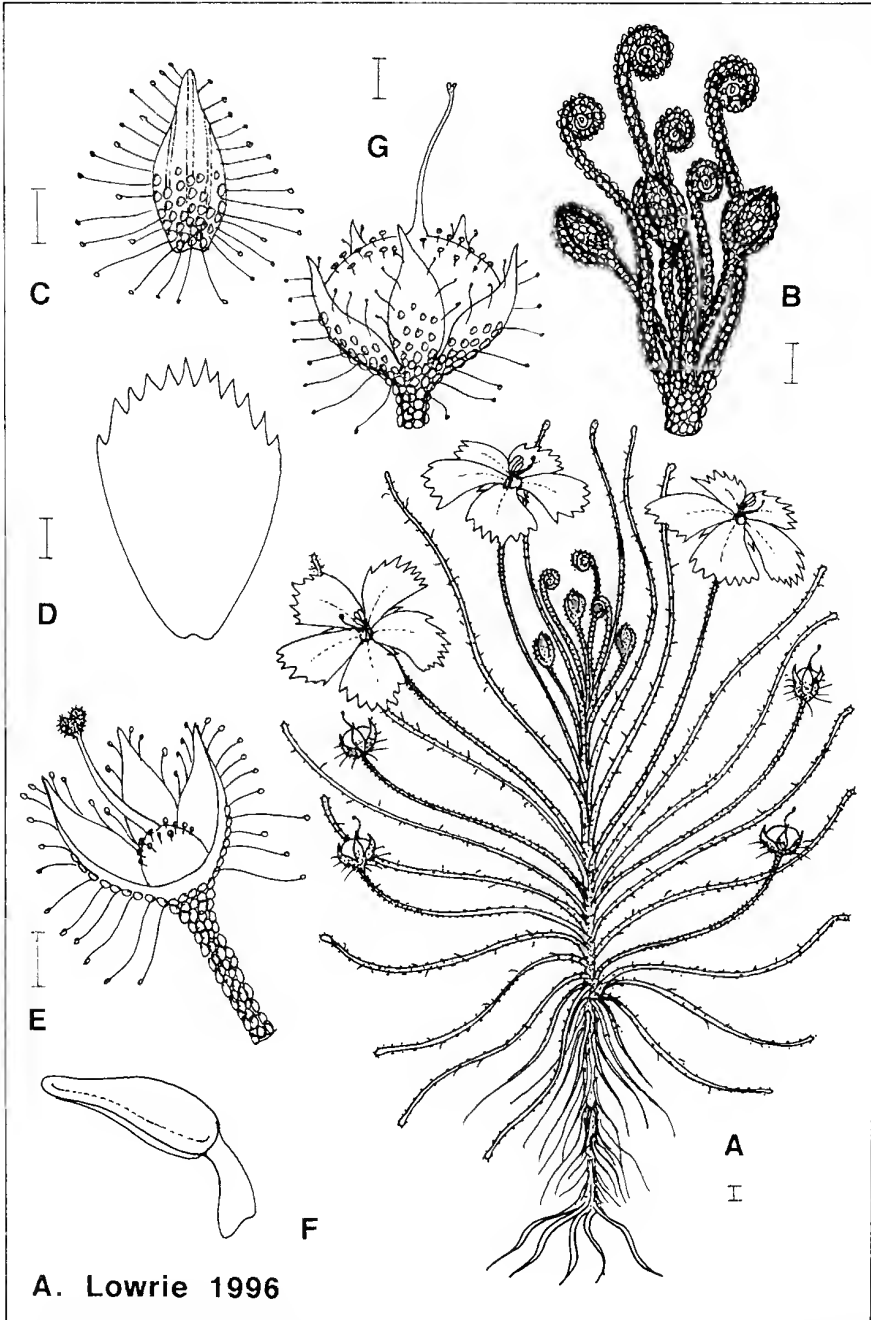


Figure 5. *Byblis rorida* A - habit of plant in flower; B - apical section of plant showing the sessile glands densely covering the juvenile leaves and flower buds; C - sepal; D - petal; E - gynoecium; F - stamen; G - seed capsule. Scale bar for all = 1 mm. Drawn from A. Lowrie & S. Geisen s.n. 10 Feb. 1995.

red rocky soil in the King Leopold Range; on undulating plateau in yellow-grey soils, on the crests of flatly bedded sandstone hills near El Questro Homestead; and in beige sand with cane grass (*Sorghum* species) in the Durack River region.

*Flowering period.* January to May.

*Conservation status.* *Byblis rorida* is known from many widespread locations in the Kimberley. It is known to be locally common in at least four of these locations and currently not under threat (A. & P. Lowrie pers. comm.).

*Etymology.* The epithet, *rorida*, is taken from the Latin, *roridus* - dewy, appearing as if covered with fine dewdrops, in reference to the many dew-like sessile glands on the pedicels, sepals and apical juvenile growth.

*Affinities.* *Byblis rorida* can be readily distinguished from *B. aquatica*, *B. filifolia* and *B. liniflora* by its sepals bearing long setae with glandular heads 0.7-1.5 mm long as well as dew-like sessile glands, pedicels (especially near the apex), sepal bases and the apical juvenile leaf growth densely covered with many dew-like sessile glands.

### Acknowledgements

We wish to thank the leaders of the 1993, 1994, 1995, 1996 and 1997 *LANDSCOPE* Expeditions for the opportunity to collect material of *Byblis* in remote regions of the Kimberley; Paul Simmons for his Northern Territory wet season field observations and collections; Russell and Matthew Barrett for their Kimberley wet season field observations and collections; The British Museum for providing Xerox copies of the type material of *Byblis caerulea*; The Royal Botanical Gardens, Kew for providing the type sheets of *B. filifolia* and other related *Byblis* collections; Paul Wilson for his assistance with the Latin diagnoses and lectotypifications; Kevin Kenneally for his comments; Barbara Rye and the two referees for reorganization and rewriting of the paper into its current form and the staff at the Western Australian Herbarium.

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## Three new species of triggerplant (*Stylidium*: Stylidiaceae) from south-west Western Australia

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### Abstract

Lowrie, A. and Kenneally, K.F. Three new species of triggerplant (*Stylidium*: Stylidiaceae) from south-west Western Australia. Nuytsia 12(1): 75-82 (1998). Three new *Stylidium* species (*Stylidiaceae*) from south-western Australia, *S. daphne*, *S. ireneae* and *S. paulineae* Lowrie & Kenneally, are described and illustrated. The location for the holotype sheet of *Stylidium coatesianum* Lowrie & Carlquist is corrected.

### Introduction

Three new species of triggerplant (*Stylidium*: Stylidiaceae) of subg. *Tolypangium* Endl. are described and illustrated. *S. daphne* and *S. ireneae* belong to sect. *Saxifragoidea* Mildbr. which comprises 25 species characterized by having rosetted linear to obovate-spathulate leaves and simple racemose inflorescences (see Mildbraed 1908). *S. paulineae* belongs to sect. *Squamosae* Benth. which comprises 14 species characterized by having graminiform, linear, lanceolate or oblanceolate-linear leaves intermixed with shorter scarious scales. The three new species, are endemic to south-west Western Australia and all have conservation priority. Their designated names honour three women, who each in their own way have supported or advanced botanical pursuits throughout the state.

An omission that occurred with respect to the location of the holotype sheet in the original description of *Stylidium coatesianum* Lowrie & Carlquist is corrected.

### Taxonomy

***Stylidium coatesianum*** Lowrie & Carlquist (Lowrie & Carlquist 1991: 8-11, Fig. 3). *Type*: In laterite soil on top of mesa east of the old homestead in the Tutanning Reserve east of Pingelly, Western Australia, 7 November 1989, Allen Lowrie 242 (*holo*: PERTH; *iso*: RSA).

*Notes*. Because of a typographical error in the original description of *Stylidium coatesianum*, the notation "(PERTH)" for the holotype location, was deleted. To correct this omission the corrected type citation is given in full above.

***Stylidium daphne* Lowrie & Kenneally, sp. nov.**

*Stylidio coatesiano* Lowrie & Carlquist affinis sed bracteis secus pedunculum subulatis, ad basim gibbosis, sparse glandulosis, pilis glandularibus ad margine fimbriatis, bracteis floralibus similaribus sed marginem tantum pilis fimbriatis glandularibus instructis; labello cum appendicibus basalibus et 8 appendicibus faucis ornatis, flavo, clavato, papilloso differt.

*Typus*: Turn off to Cheynes Beach, off Hassell Highway, 19 km north west of beach, Western Australia, 34° 49' S, 118° 16' E, 20 December 1993, K.F. Kenneally 11424 (*holo*: PERTH 03061043; *iso*: MEL, NSW).

Erect perennial herb 25-35 cm high (including inflorescence); stem 3.5-5 cm long, with rosette nodes bearing 2 prop roots (the product of the basal portions of a previous seasons' leafy rosette growth) positioned along the stem, stolons 4-7 mm long, glabrous, basal portions of old peduncles often present on the upper rosette nodes. *Leaves* linear, shortly spurred at the base, acute at the apex (leaf tips often bent inwards on a small number of leaves within a terminal rosette), 1-3 cm long, 1-1.3 mm wide, slightly U-curved in section, 0.2-0.3 mm thick, densely covered with translucent-white, non-glandular hairs. *Inflorescence* racemose, 22-28 cm long (including peduncle), glabrous. *Bracts* along the peduncle subulate, gibbose at the base, 2.5-4 mm long, sparsely glandular, with glandular hairs fimbriate along the margins; floral bracts similar but bearing only fimbriate glandular hairs along the margins, 1.5-2.5 mm long; bracteoles opposite, subulate, 0.5-0.7 mm long, glabrous. *Pedicels* 3-7 mm long, mostly glandular-hairy between the bracteoles and hypanthium. *Hypanthium* obovoid, 1.7-2 mm long, 1-1.4 mm diam. at anthesis, glabrous. *Sepals* 5, all free to the base, lanceolate, 1.4-1.7 mm long, glabrous. *Corolla* adaxial surface dark yellow, abaxial surface of all lobes yellow with large central dark maroon-spotted red wine-coloured marks, lobes laterally paired, glabrous; anterior lobes oblong, 2.8-4 mm long, 1-1.8 mm wide, margins near labellum bearing c. 6 glandular hairs; posterior lobes oblong, 2.5-4 mm long, 1-2 mm wide. *Throat* appendages 8, yellow, clavate, papillose, shortest pair c. 0.6, longest pair c. 0.8 mm long. *Labellum* twisted to one side and appressed to 1 sepal; boss elliptic, c. 0.6 mm long, c. 0.4 mm wide, positioned below the base of the corolla tube sinus, attached by a short bridge, apical point c. 0.6 mm long; basal appendages c. 0.2 mm long. *Gynostemium* 4.5-6.7 mm long; anthers maroon, pollen pale yellow; stigma orbicular, cushioned-shaped, c. 0.5 mm diam. *Capsule* obovoid, 4-4.5 mm long, 1.7-2 mm diam. Seeds brown, ellipsoid, ruminate, 0.5-0.6 mm long, 0.2-0.25 diam. (Figure 1)

*Distribution*. Known only from the type location and observed but not collected at two locations (4.7 km and c. 20 km) to the north east.

*Habitat*. Grows in damp sand amongst low heath at the type location; in sandy pockets of soil on the summit of a predominantly laterite hill amongst heath and scrub land with *Stylidium imbricatum* Benth. at a second location; and in sandy soil amongst low heath at a third location.

*Stylidium daphne* is a well camouflaged and a difficult species to locate in the field when it is not in flower. The leafy rosettes are mostly closely intermingled with other scrub and heathland species where they are well hidden from view.

*Flowering period*. December-January.

*Conservation status*. CALM Conservation Codes for Western Australian Flora: Priority Two.

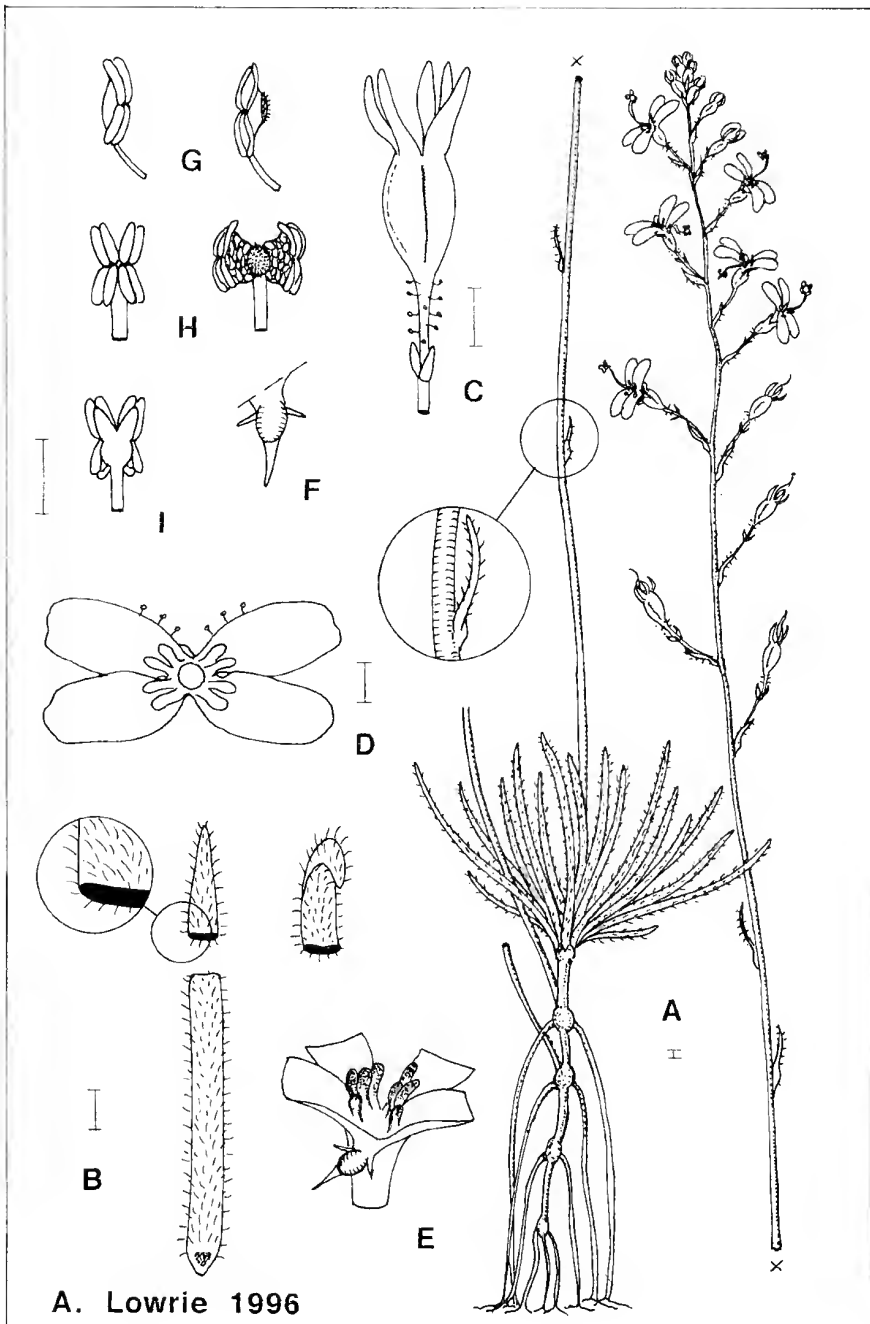


Figure 1. *Stylidium daphne* A - habit of flowering plant with enlarged view of peduncle bract left; B - leaf with enlarged portion and inward bent leaf tip right; C - hypanthium; D - corolla; E - lateral view of throat appendages and labellum; F - labellum; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium tip. Scale bar = 1 mm. Drawn from K.F. Kennelly 11424.

*Affinities.* The nearest relative to *Stylidium daphne* is *S. coatesianum* Lowrie & Carlquist. Both species have leaves densely covered with translucent-white non-glandular hairs and yellow flowers. *S. daphne* differs from *S. coatesianum* (whose contrasting characters are given in parentheses) by having bracts along the peduncle subulate, gibbose at the base, sparsely glandular, with glandular hairs fimbriate along the margins, floral bracts similar but bearing only fimbriate glandular hairs along the margins (lower peduncle bracts when present covered with translucent-white non-glandular hairs, upper peduncle bracts and floral bracts glabrous); labellum with basal appendages (labellum without basal appendages); and throat appendages 8, yellow, clavate, papillose (throat appendages 4, lacinate, with brown tips, alternating with 3 additional rounded and shining appendages).

*Etymology.* The specific epithet *Stylidium daphne* is named in honour of Daphne Joan Choules Edinger, botanist, entomologist, biology teacher and honorary CALM scientist. In this latter volunteer capacity she has assisted Kevin Kenneally for over fourteen years with research projects.

***Stylidium ireneae* Lowrie & Kenneally, *sp. nov.***

*Stylidido rupestri* Sond. affinis sed foliis sparsissime pilosis cum pilis non-glandulosis vel fere glabris, caulibus innovationum longitudinaliter porcatis, floribus pallido roseis differt.

*Typus:* Icy Creek, north of Dawn Creek Rd, east north east of Waroona, Western Australia [precise locality withheld], 29 October 1994, A. Lowrie 1068 (*holo:* PERTH 04675479; *iso:* MEL).

Erect perennial herb 10-30 cm high (mostly c. 18 cm high) including inflorescence, forming a small compact bush up to 15 cm in diam., rosette nodes situated on the soil surface or shortly prop-rooted, connected by leafless stolons 4-5 cm long, 1-4 or more new shoots arising from each rosette node, 3-5 cm long; stems maroon-coloured, 3-4 cm long, longitudinally ridged, sparsely glandular-hairy, with a few caducous leaves and a terminal rosette of crowded leaves. *Leaves* oblanceolate-spathulate, 12-20 mm long, 0.6-0.8 mm wide at the base, 3-5 mm wide near the apex, lunate in section, c. 0.2 mm thick, minutely mucronate at apex, very sparsely hairy or almost glabrous; hairs translucent-white non-glandular. *Inflorescence* racemose, usually 6-10 cm long (including peduncle), sparsely glandular-hairy. *Bracts* subulate, 2-3 mm long, glabrous; bracteoles similar, opposite, 0.6-1 long. *Pedicels* 5-8 mm long, glandular-hairy. *Hypanthium* oblong, 1.8-3 mm long, 0.7-1.3 mm diam. at anthesis, usually glabrous but sometimes with a few glands at the base. *Sepals* 5, all free to the base, subulate, 1.7-2.3 mm long, glabrous. *Corolla* adaxial surface pale pink, abaxial surface whitish pink, glabrous, lobes laterally paired; anterior lobes obovate-elliptic, 3.5-6.5 mm long, 1.6-3 mm wide; posterior lobes elliptic, 4.5-6 mm long, 1.5-2.5 mm wide. *Throat* silvery white, surrounded by reddish marks; appendages 8, triangular, silvery white, tips papillose. *Labellum* twisted to one side and appressed to 2 sepals but reaching only half way across the second sepal; boss elliptic, white with maroon around one margin, c. 0.8 mm long, c. 0.5 mm wide, positioned at the base of the corolla tube sinus, apical point white and c. 0.8 mm long; basal appendage 1, minute, maroon. *Gynostemium* 6.5-8 mm long; anthers blackish maroon, pollen greyish purple; stigma conical, capitate, c. 0.4 mm long, c. 0.4 mm diam. *Capsule* obovoid, 3-4 mm long, 1-1.5 mm diam. *Seeds* blackish brown, broadly ellipsoid, smooth, 0.4-0.5 mm long, 0.3-0.35 diam. (Figure 2)

*Distribution and habitat.* Known only from the type location. Grows in sandy loam on watershed of creek line.

*Flowering period.* October-November.

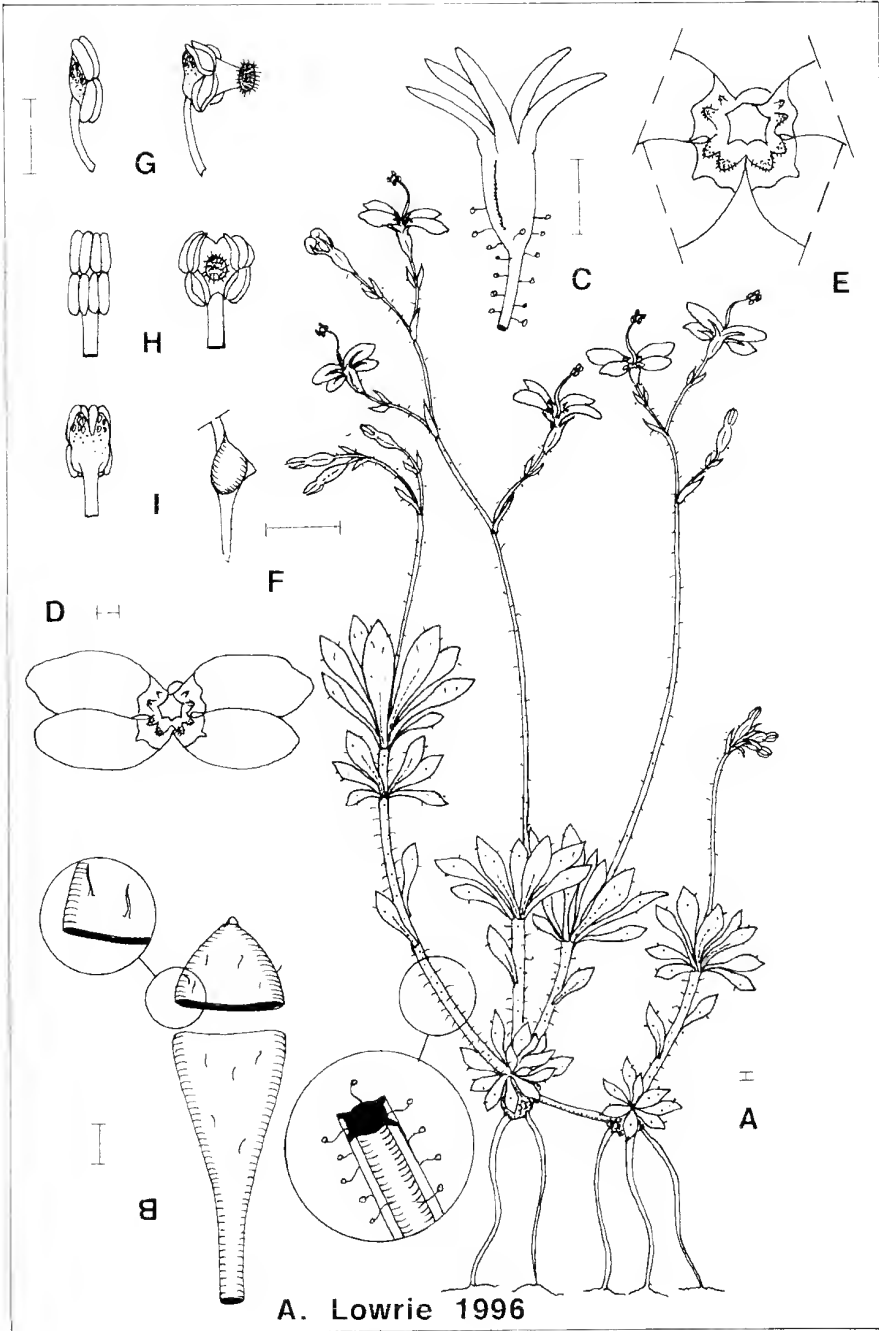


Figure 2. *Stylidium ireneae* A - habit of flowering plant with enlarged view of longitudinally ridged stem section; B - leaf with enlarged portion; C - hypanthium; D - corolla; E - throat appendages, enlarged; F - labellum; G - lateral view of gynostemium tip (with stigma at right); H - front view of gynostemium tip (with stigma grown out, right); I - back of gynostemium tip. Scale bar = 1 mm. Drawn from A. Lowrie 1068.

*Conservation status.* CALM Conservation Codes for Western Australian Flora: Priority One.

*Affinities.* The nearest relative to *Stylidium ireneae* is *S. rupestre* Sond. *S. ireneae* differs from *S. rupestre* (whose contrasting characters are given in parentheses) by having leaves glabrous or with a few non-glandular hairs (leaves glandular-hairy); stems longitudinally ridged (stems not longitudinally ridged); and flowers pale pink (flowers cream to pale yellow).

*Etymology.* The specific epithet *Stylidium ireneae* is named in honour of Irene Ioannakis, wife of Kevin Kenneally, in recognition of her support and companionship over many years of botanical endeavour. It is also an acknowledgement of her personal contribution to education and training in Western Australia.

***Stylidium paulineae* Lowrie & Kenneally, *sp. nov.***

*Stylidio schoenoides* DC. affinis sed foliis linearibus ad 2.5-4 cm longis, 0.6-1 mm latis, foliis in eadem caespitem glabris, mucronatis, corolla pallido rosea 11-18 mm longa, et gynostemii 4.8-6 mm longa differt.

*Typus:* Bowelling-Duranilin road, 2 km from junction of Roelands-Lake King highway, south west of Darkin, Western Australia, 33° 27' S, 116° 30' E, 31 October 1994, A. Lowrie 1078 (*holo:* PERTH 04675487; *iso:* MEL).

Perennial scale-leaved *herb* forming a crowded leafy tuft on prop-roots 1.5-2 cm above the soil surface. *Scale leaves* subulate, 10-12 mm long, 1-1.3 mm wide, of a papery texture with a thickened midrib. *Leaves* linear, 2.5-4 cm long, 0.6-1 mm wide, depressed ovate in section with the addition of 2 fine shallow longitudinal grooves on the adaxial surface and 2 deeper longitudinal grooves bearing smooth epidermis cells in the valleys on the abaxial surface, 0.3-0.5 mm thick, indumentum of two types both within the same leafy tuft, the older winter leaves (generally few in number) scabrid on the adaxial surface and margins, abaxial surface glabrous, other than a few transitional leaves still bearing a few scabrid projections all other leaves within the leafy tuft glabrous at anthesis, apical mucro sharp 0.3-0.5 mm long. *Inflorescence* simple, corymbose, 5-10 cm long (including peduncle), glandular-hairy, peduncle pilose as well as glandular-hairy. *Bracts* 2.5-5 mm long, glandular-hairy; bracteoles alternate, 2-3 mm long glandular-hairy. *Pedicels* 3-18 mm long. *Hypanthium* ellipsoid, 2.5-4 mm long, 1.5-2.5 mm diam. at anthesis, densely glandular-hairy. *Sepals* 5, all free to the base, oblanceolate, 3 sepals 4-4.5 mm long, 2 sepals 3-3.5 mm long, densely glandular-hairy. *Corolla* adaxial surface pale pink, often with dark pink margins on the anterior lobes, abaxial surface whitish pink often with dark pink on the margins of anterior lobes, slightly glandular, lobes vertically paired; anterior lobes obovate-spathulate, 5-8 mm long, 3-5 mm wide, cruciate as well as bent backwards a little at the apex to form a forward-projected hood over the gynostemium, glandular-hairy on margins of the hood opening; posterior lobes elliptic, 6-10 mm long, 4.5-6 mm wide. *Throat* yellow surrounded by reddish marks; appendages 6, yellow, capitate, with silver hairs on the capitate apex. *Labellum* pale yellow, ovate, c. 2 mm long, c. 1 mm wide, with red-tipped glands on the margins; boss ovate, c. 0.7 mm long, c. 0.4 mm wide; basal appendages capitate, c. 0.3 mm long. *Gynostemium* 4.8-6 mm long; anthers yellow, vertically paired, pollen white; stigma elliptic, cushioned-shaped, c. 0.9 mm long, c. 0.4 mm wide. *Capsule* spherical, 8-10 mm long. *Seeds* rust-coloured, elliptic, alveolate, 2-2.5 mm long, 1.2-1.6 mm wide, transverse-linear in section, 0.3-0.4 mm thick. (Figure 3)

*Other specimens examined.* WESTERN AUSTRALIA: Lupton Wandoo Conservation Park, 32 km W of Brookton, 32° 26' 59" S, 116° 39' 25" E, 17 Sep. 1997, R. Davis 4151B (PERTH); State forest NE of intersection of Yarra Road and Brookton Highway, 32° 14' S, 116° 27' E, 2 Oct. 1995, M. Hislop 206 (PERTH).

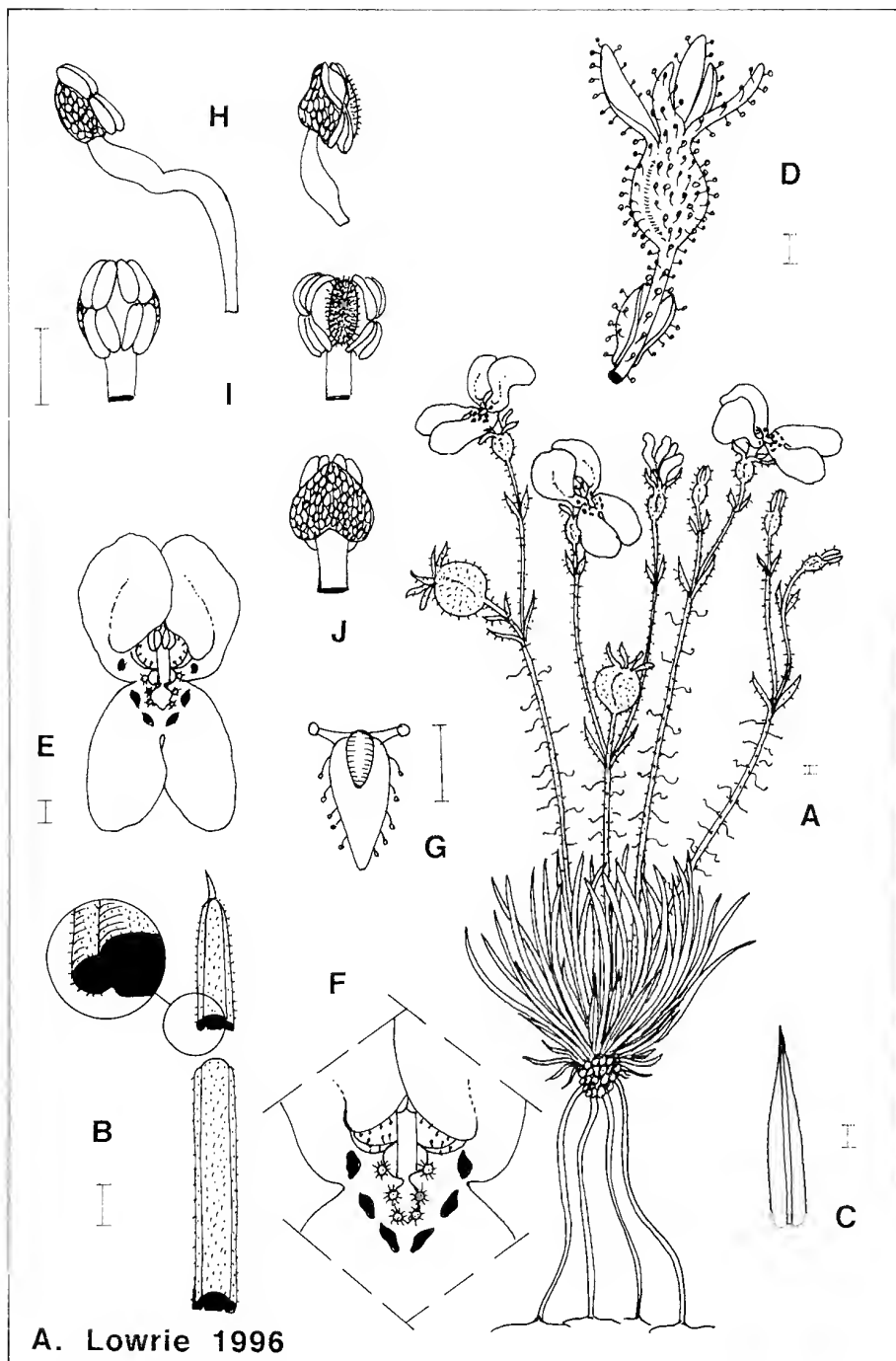


Figure 3. *Stylidium paulineae* A - habit of flowering plant; B - leaf bearing scabrid indumentum with enlarged portion; C - scale-leaf; D - hypanthium; E - corolla; F - throat appendages, enlarged; G - labellum; H - lateral view of gynostemium tip and column (with stigma at right); I - front view of gynostemium tip (with stigma grown out, right); J - back of gynostemium tip. Scale bar = 1 mm. Drawn from A. Lowrie 1078.

*Distribution and habitat.* Known only from the type locality and two additional localities 130 km to the north in State Forest west of Brookton. Grows in lateritic gravel and loam over sheet laterite in open wandoo and jarrah woodland.

*Flowering period.* September-November.

*Conservation status.* CALM Conservation Codes for Western Australian Flora: Priority Two.

*Affinities.* The nearest relative to *Stylidium paulineae* is *S. schoenoides* DC. (whose contrasting characters are given in parentheses) from which it differs by having leaves 2.5-4 cm long (leaves 15-40 cm long); leaf indumentum of two types both scabrid and glabrous within the same leafy tuft (all leaves glabrous); leaves bearing a sharp apical mucro (apical mucro absent); corolla pale pink, 11-18 mm long (corolla white, 30-40 mm long); and gynostemium 4.8-6 mm long (gynostemium 13-19 mm long).

*Etymology.* *Stylidium paulineae* is named in honour of Pauline Lowrie, wife, companion and research assistant to Allen Lowrie.

*Notes.* *Stylidium paulineae* is a remarkable species within the genus. The very short gynostemium is housed within the hood-like arrangement of the anterior petals in both the set and triggered positions. Pollinators are attracted and directed by throat appendages and colour markings into the hood, where pollen is deposited on or retrieved from the upper parts of the pollinator's body by the action of the gynostemium.

*Stylidium paulineae* has been discovered growing with *S. schoenoides* (A. Lowrie 1080 PERTH) at the type location. Both species were flowering at the time of collection and no hybrids or intermediate forms of either species were found.

### Acknowledgements

We would like to thank Paul Wilson for his assistance with the Latin diagnoses; the referee Juliet Wege for her suggestions and comments, Barbara Rye for her helpful reorganisation, rewriting suggestions and comments, and the staff of the Western Australian Herbarium (PERTH).

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## Nomenclatural notes and new taxa in the genera *Asterolasia*, *Drummondita* and *Microcybe* (Rutaceae: Boronieae)

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### Abstract

Paul G. Wilson. Nomenclatural notes and new taxa in the genera *Asterolasia*, *Drummondita* and *Microcybe* (Rutaceae: Boronieae). Nuytsia 12(1): 83-88 (1998). Material is provided to validate the names to be used in a forthcoming treatment of Rutaceae in the "Flora of Australia". Two new species and two new subspecies are described: *Asterolasia rivularis* Paul G. Wilson, *A. pallida* subsp. *hyalina*, *Drummondita microphylla*, and *Microcybe pauciflora* subsp. *grandis*. Two new combinations are made: *Drummondita longifolia* (Paul G. Wilson) Paul G. Wilson and *Microcybe multiflora* subsp. *baccharoides* (F. Muell.) Paul G. Wilson. Several names are lectotypified.

### Introduction

The family Rutaceae will be included in Volume 26 of the "Flora of Australia". The present paper is a precursor to that treatment and deals with the genera *Asterolasia*, *Drummondita*, and *Microcybe*. These genera, apart from each being a member of the tribe Boronieae, have no close affinity; they are here treated together solely for the sake of convenience.

### *Asterolasia* F. Muell.

***Asterolasia asteriscophora*** (F. Muell.) Druce, Bot. Soc. Exch. Club Brit. Isles Rep. 4: 606 (1917). - *Phebalium asteriscophorum* F. Muell., Trans. Proc. Vict. Instit. Advance. Sci. 31 (1855). - *Asterolasia muelleri* Benth. *nom. illeg.*, Fl. Austral. 1: 350 (1863). - *Asterolasia correifolia* var. *muelleri* Maiden & E. Betcher, Proc. Linn. Soc. New South Wales 26: 80 (1901). *Type citation*: On stony declivities of Mount Disappointment (Dallachy) and on the gravelly banks of the Buffalo Creek. *Type*: Mt Disappointment, Victoria, October 1852, F. Mueller (*lecto*, here chosen: MEL 708656).

*Notes*. The lectotype specimen from Mt Disappointment at MEL is labelled as having been collected by Mueller although credited to Dallachy by Mueller in his protologue. It is possible that Dallachy should have been indicated as the collector of the Buffalo Creek collection since he and Mueller were together on the expedition to that area in 1853 (Gillbank 1992).

**Asterolasia buxifolia** Benth., Fl. Austral. 1: 351 (1863). *Type citation*: Blue Mountains, A. and R. Cunningham. *Type*: Bells Road, Blue Mountains, New South Wales, 1834, R. Cunningham (*lecto*, here chosen: K).

*Notes*. The specimens I have seen of this species were all collected in the Blue Mountains in the 1830s and 1840s. In recent floras *A. buxifolia* has either been ignored or treated as a synonym of *A. asteriscophora*; it differs from the latter species, and from other eastern Australian species, in having glabrous carpels and in having thick solid golden centres to the stellate hairs of its petals. This type of petaline hair is similar to that found in the Western Australian species *A. grandiflora* and *A. nivea*. A projected attempt by Keith Ingram in 1994 to re-collect the species was thwarted by fires that burnt through the Bells Road area.

**Asterolasia pallida** Benth., Fl. Austral. 1: 352 (1863). *Type*: Western Australia, J. Drummond 42 & 112 (*syn*: K, MEL).

*Woody perennial* to 1 m high, sometimes rhizomatous. *Leaves* petiolate, elliptic to broadly elliptic, 1-2.5 cm long, somewhat scabridulous. *Umbels* terminal and axillary. *Sepals* stellate-hairy and insignificant or glabrous and c. 0.5 mm long. *Petals* 4-8 mm long, white, covered on outside with colourless or rufous stellate hairs radiating in all directions. *Stamens* c. 15-25, glabrous; anthers c. 0.8 mm long. *Carpels* 1-3; style glabrous. *Cocci* with prominent horizontal beaks.

*Distribution*. Found in Western Australia in the Darling Range from near Perth south to Manjimup.

*Notes*. Two subspecies are recognized.

Petals with rufous and colourless hairs outside ..... subsp. **pallida**

Petals with a few colourless hairs only ..... subsp. **hyalina**

**Asterolasia pallida** Benth. subsp. **pallida**

*Sepals* scarcely observable, rufous stellate-hairy. *Petals* with rufous and colourless stellate hairs outside.

*Distribution*. Found in Western Australia in the Darling Range from near Perth south to Manjimup.

*Habitat*. Growing on laterite in *Eucalyptus marginata* - *Corymbia calophylla* woodland.

*Conservation status*. A widespread taxon which is not under threat.

*Notes*. The variant that grows in the Darling Range near Perth has flowers with broadly elliptic petals c. 8 mm long, and with 2 or 3 carpels. A southern variant, found between Augusta and Manjimup, has flowers with very broadly elliptic petals 4-5 mm long, and 1 or 2 carpels; it is sometimes rhizomatous.

**Asterolasia pallida** subsp. **hyalina** Paul G. Wilson, *subsp. nov.*

*A Asterolasis pallida subsp. pallida sepalis late triangularibus c. 0.4 mm longis fere glabris, petalis extra sparse stellatis cum pilis debilibus incoloratis differt.*

*Typus*: Dryandra [State Forest], Western Australia, 5 September 1992, G.J. Keighery 12276 (*holo*: PERTH 3341410).

*Sepals* broadly triangular, *c.* 0.4 mm long, glabrous or almost so. *Petals* sparsely stellate-hairy outside with weak colourless hairs.

*Additional specimen examined.* WESTERN AUSTRALIA: Dryandra State Forest, G.J. Keighery 12284 (PERTH).

*Distribution.* Occurs in Dryandra State Forest *c.* 130 km south-east of Perth, Western Australia.

*Habitat.* Growing in *Eucalyptus wandoo* woodland over granite.

*Conservation status.* The few known populations of this subspecies are in a conservation reserve. A Priority Two classification would appear to be appropriate.

*Etymology.* The subspecific epithet *hyalina* is derived from the Latin word *hyalinus*, which means colourless and transparent, referring to the transparent hairs on the petals.

***Asterolasia phebaloides*** F. Muell., Trans. Philos. Soc. Victoria 1: 10 (1854). - *Eriostemon pleurandroides* F. Muell. *nom. illeg.*, Fragm. 1: 106 (1859) based on above. - *Asterolasia pleurandroides* Benth. *nom. illeg.*, Fl. Austral. 1: 351 (1863). - *Pleurandropsis phebaloides* (F. Muell.) Baill., Adansonia 10: 306 (1872). *Type citation:* On the stony declivities of the Grampians, the Serra and Victoria Ranges, particularly frequent on Mount Sturgeon and Mount Abrupt. *Type:* Grampians, Victoria, November 1854, F. Mueller (*lecto*, here chosen: MEL 708616).

*Notes.* This species has five leafy to scarious bracts that subtend each flower. These bracts occur in an inter-petaline position and may be modified sepals.

***Asterolasia rivularis*** Paul G. Wilson, *sp. nov.*

Folia anguste oblonga vel anguste oblongo-cuneata, *c.* 15 mm longa, 2.5 mm lata, obtusa, supra profunde canaliculata, muricata, infra dense stellato tomentosa. Flores 1-3; pedicellus ad 3 mm longus. Sepala triangularia, *c.* 1 mm longa. Petala late elliptica, *c.* 6 mm longa, flava, extra rubiginoso stellata.

*Typus:* Avon Dam district, New South Wales, 27 July 1947, E.F. Constable (*holo:* NSW 3979).

Erect *shrub* to 1.5 m high. *Leaves* narrowly oblong to narrowly oblong-cuneate, *c.* 15 mm long, 2.5 mm wide, obtuse, deeply sulcate above with the lateral halves convex, muricate above, densely stellate-tomentose below. *Flowers* 1-3 in sessile axillary and terminal clusters; pedicels to 3 mm long in flower. *Sepals* triangular, *c.* 1 mm long. *Petals* broadly elliptic, *c.* 6 mm long, yellow, rusty-stellate-hairy outside. *Stamens* 10; anthers *c.* 1.5 mm long with a small terminal gland. *Carpels* 5, stellate-hairy; style glabrous; stigma subglobular, minutely verrucose. *Fruit* not seen.

*Additional specimen examined.* NEW SOUTH WALES: Little River, Buxton, T.M. Whaite 1080 (NSW).

*Distribution.* Found on the central coast of New South Wales near Buxton.

*Habitat.* Occurs in the hills along streams.

*Etymology.* The Latin word *rivularis*, which applies to streams, refers to the preferred habitat of this species.

*Notes.* This species is similar to *A. asteriscophora* (F. Muell.) Druce from which it differs principally in leaf shape.

### **Drummondita** Harv.

**Drummondita longifolia** (Paul G. Wilson) Paul G. Wilson, *comb. et stat. nov.*

*Drummondita hassellii* var. *longifolia* Paul G. Wilson, Nuytsia 1: 206 (1971). *Type:* Peak Charles National Park, Western Australia, 15 June 1929, *C.A. Gardner & G.L. Throssell* (*holo:* PERTH 1004891).

*Conservation status.* This species is known from only a small area. Currently listed as Declared Rare Flora.

*Notes.* This species differs from *D. hassellii* in having well-spaced slender leaves and in having resinous sepals and branchlets. With the removal of var. *longifolia*, *D. hassellii* still remains an extremely variable species, particularly in respect to the size and shape of the leaves.

**Drummondita microphylla** Paul G. Wilson, *sp. nov.*

Ramuli in statu juveniles nitidi albique, cristis brevis rotundatis glanduloso-verrucosis ex foliis decurrentibus. Folia congesta, subteretia, crassa, carnosa, 2-3 mm longa, glabra, apice rotundata. Flores solitarii; pedicellus nullus. Sepala inaequalia, triangularia vel sub-orbicularia, 2-4 mm longa, sparse ciliata aliter glabra, rubra, margine scariosa, aliter crassa, carnosa. Corolla tubularis; petala c. 13 mm longa, glabra, sanguinea. Staminorum tubus 1.5-2 cm longus, dense sericeus, rubra; anthera 3 mm longa.

*Typus:* Bulga Downs Station, Western Australia, 23 August 1993, *K.H. Coate* 295 (*holo:* PERTH 03282007; *iso:* CANB, K, MEL, NSW).

*Shrub*, much branched, c. 1.5 m high. *Branchlets* glossy and white when young with short raised rounded glandular-verrucose glabrous ridges decurrent from the leaf-bases, sparsely hirtellous between the ridges. *Leaves* crowded, fleshy, subterete, thick, 2-3 mm long, smooth, glabrous, sulcate above, apex rounded. *Flowers* solitary; pedicel turbinate, fleshy, c. 1.5 mm long, glabrous; bracteoles absent. *Sepals* unequal, triangular to suborbicular, 2-4 mm long; sparsely ciliate, otherwise glabrous, red; margin thin; centre raised and fleshy. *Corolla* tubular; petals narrowly oblong-ovate, c. 13 mm long, glabrous, blood-red. *Staminal tube* 1.5-2 cm long, densely silky, red; anthers 3 mm long.

*Additional specimens examined.* WESTERN AUSTRALIA: Between Fields Find and Yalgoo, 24 Aug. 1990, *K. Coate* (PERTH); 30 km SE of Bulga Downs Homestead, *P.G. Wilson* 13055 (PERTH).

*Distribution.* Found on Bulga Downs Station between Sandstone and Menzies in southern Western Australia.

*Habitat.* Only known from plants that are growing on breakaways.

*Conservation status.* This species has been found on several breakaways and does not appear to be in need of protection.

*Etymology.* The epithet *microphylla* is made up of the two Greek words *micro* - small, and *phyllon* - leaf, and has reference to the small leaves found in this species.

*Notes.* A plant similar to *D. microcephala* is found in the Blue Hill Range, c. 300 km west of the above locality (R.J. Cranfield 8586A, PERTH). It differs from typical *D. microcephala* in having minute reddish brown apicula to the leaves and suborbicular flat coriaceous sepals. This variant may warrant recognition as a distinct taxon, however, since it is only known from a small specimen which bears one flower it is not appropriate that it should be formally described.

### **Microcybe Turcz.**

**Microcybe multiflora** Turcz. subsp. **baccharoides** (F. Muell.) Paul G. Wilson, *comb. nov.*

*Eriostemon capitatus* F. Muell. var. *baccharoides* F. Muell., *Fragm.* 9: 107 (1875). - *Microcybe multiflora* var. *baccharoides* (F. Muell.) Ewart & Tovey, *Proc. Roy. Soc. Victoria ser. 2*, 32: 201 (1920). *Type citation:* Fowler's Bay E. Giles, ad Gawler's Range D. Sullivan, ad Port Eucla J. Forrest. *Type:* Near Port Eucla, 1870, J. Forrest (*lecto*, here chosen: MEL 232732).

*Distribution.* Found from Lake King south to Ravensthorpe in Western Australia eastwards to Eyre Peninsula in South Australia.

*Habitat.* Frequently in mallee scrub where predominantly in calcareous soil.

*Notes.* A variant of subsp. *baccharoides* that has thick, deltoid leaves c. 2 mm long, tightly appressed to and almost obscuring the branch, is found from Ravensthorpe in Western Australia to Eyre Peninsula in South Australia. Where this variant and subsp. *multiflora* grow together plants intermediate in form are also found. The three syntypes of subsp. *baccharoides*, cited above, appear to be of this intermediate variant. However, the Forrest collection comes close to the putative parental variant that has tightly appressed leaves and it has therefore been selected as the lectotype of this subspecies. The variant with tightly appressed leaves has only been recorded from soils with calcareous substrates.

**Microcybe pauciflora** Turcz., *Bull. Soc. Imp. Naturalistes Moscou* 25/2: 167 (1852). *Type:* Western Australia, J. Drummond 5: 209 (*holo:* KW photo seen; *iso:* MEL, TCD).

*Branchlets* smooth, silvery stellate-hairy to lepidote. *Leaves* sessile, spreading, sub-terete due to the revolute margins, 5-16 mm long, 1-2.5 mm wide; upper surface glandular-punctate and sparsely scabridulous from the persistent hair bases. *Flowers* 5-12 in head. *Sepals* free, narrowly oblong, 1-2 mm long, stellate-lepidote. *Petals* glabrous or sparsely stellate-hairy, pale yellow. *Staminal filaments* stellate-lepidote near base.

*Notes.* Two subspecies are recognized.

Leaves 4-10 mm long; petals glabrous ..... subsp. **pauciflora**  
 Leaves 14-16 mm long; petals sparsely stellate-hairy ..... subsp. **grandis**

**Microcybe pauciflora** Turcz. subsp. **pauciflora**

*Asterolasia chorilaenoides* F. Muell., *Defin. Austral. Pl.* 38 (1855). - *Eriostemon capitatus* F. Muell.,

Fragm. 1: 106 (1859). *Type*: Near Lake Hamilton, South Australia, *C. Wilhelmi* (*holo*: MEL 4539; *iso*: TCD).

*Leaves* 4-10 mm long, *c.* 1 mm wide, stellate-lepidote below. *Flower-heads* subtended by leafy bracts equal to or shorter than the head. *Sepals* *c.* 1 mm long. *Petals* glabrous.

*Distribution*. Found from south of the Stirling Range in Western Australia eastwards along the Great Australian Bight to southern South Australia and north-east Victoria.

***Microcybe pauciflora* subsp. *grandis*** Paul G. Wilson, *subsp. nov.*

Folia 14-16 mm longa, *c.* 2 mm lata. Bractei foliacei capitulum excedentes. Sepala 1.5-2 mm longa.

*Typus*: 40 km north-east of Lake King, Western Australia, 16 September 1989, G. Barrett HAT 24 (*holo*: PERTH 1004638).

*Leaves* 14-16 mm long, *c.* 2 mm wide, stellate-velvety beneath. *Flower-heads* subtended by leafy bracts exceeding the head. *Sepals* 1.5-2 mm long. *Petals* sparsely stellate-hairy outside.

*Additional specimen examined*. WESTERN AUSTRALIA: NE of Lake King, K. Newbey 6546 (PERTH).

*Distribution*. Found north-east of Lake King, Western Australia.

*Habitat*. Newbey records that it grows in a moderately exposed situation on a kaolinitic breakaway in well-drained loam. Barrett indicates that it was growing in *Casuarina*-mallee scrub in clay loam.

*Conservation status*. This subspecies is known from only a small area whose security is uncertain. A Priority One category would appear to be appropriate.

*Etymology*. The Latin epithet *grandis*, which means large or great, refers to the fact that the leaves and flower-heads are larger than in the typical subspecies.

*Notes*. This subspecies is restricted to a small area north-east of Lake King, in the Roe Botanical District (Beard 1980) of Western Australia. The typical subspecies is found further south, from the Fitzgerald River in Western Australia eastwards to north-western Victoria.

### Acknowledgements

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## Notes on the genus *Correa* (Rutaceae)

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### Abstract

Wilson, Paul G. Notes on the genus *Correa* (Rutaceae). Nuytsia 12 (1): 89-105 (1998). Nomenclatural notes are provided in preparation for an account of *Correa* (Rutaceae) in Volume 26 of the "Flora of Australia". *Correa eburnea*, *C. backhouscana* var. *orbicularis*, *C. calycina* var. *halmaturorum*, *C. lawrenceana* var. *grampiana*, *C. reflexa* var. *lobata*, *C. reflexa* var. *scabridula*, *C. reflexa* var. *angustifolia*, and *C. reflexa* var. *insularis* are described as new. The following new varietal combinations are made: *C. backhouseana* var. *coriacea* (Paul G. Wilson) Paul G. Wilson, *C. glabra* var. *leucoclada* (Lindl.) Paul G. Wilson, *C. glabra* var. *turnbullii* (Ashby) Paul G. Wilson, *C. lawrenceana* var. *latrobeana* (Hannaford) Paul G. Wilson, and *C. reflexa* var. *speciosa* (Andr.) Paul G. Wilson.

### Introduction

*Correa* Andr. is a member of the tribe Boronieae (Rutaceae), and the sole representative of the subtribe Correinae (Engler 1931). It is endemic to Australia and is one of the most clearly circumscribed genera in the Boronieae, with possibly *Boronia* its closest relative. A revision of the genus by Wilson (1961) did not adequately clarify the complex variation found in some species, which led Anderson (1983) to re-assess the status of all the species in the genus and to propose a number of changes. His doctoral thesis, which is largely a comparison of the chemistry of the various taxa, has not been published, although an indication of some of his conclusions was given in his treatment of the genus in the fourth edition of the "Flora of South Australia" (Anderson 1986). Anderson's work appears to have been largely based on his own collections which, although widespread, were limited in relation to the total distribution of the various species in the genus and therefore failed to take account of the overall variation.

A treatment that I have prepared for the "Flora of Australia" is based entirely on herbarium collections and lacks the authority that it might be accorded had it been supported by the study of field populations, however, the field observations recorded by Anderson have been important in this regard. In this genus such field knowledge is particularly valuable since all species, except for *C. lawrenceana* and *C. baeuerlenii*, appear to hybridize freely when growing together and in *C. lawrenceana* intraspecific variation is common.

During the preparation of the flora account it became apparent that some names required lectotypification, that some varieties were incorrectly placed, and that some additional taxa required recognition. These matters are dealt with below.

### Nomenclatural notes and new taxa

**Correa alba** Andrews, Bot. Repos. 1: t.18 (1798). *Type*: Port Jackson, New South Wales, raised in 1793 from seeds given by *J. Banks* to *J. Vere* (*holo*: Bot. Repos. 1: t. 18).

*Mazeutoxeron rufum* Labill., Voy. Rech. Perouse 2:12 (1800), Atlas t. 17 (1800). - *Correa rufa* (Labill.) Vent., Jard. Malm. 1: sub. t. 13 (1803). - *C. alba* var. *rotundifolia* DC., Prod. 1: 719 (1824), based on *M. rufum*. *Type*: Near "cap. meridional" [South Cape], Tasmania, February 1793, *J.J.H. de Labillardiere* (Fl, n.v., photographs at PERTH).

*Notes*. The illustration of the flower of *Mazeutoxeron rufum* in Figure 2 of tab. 17 appears to correspond to the flower of *Correa alba*, and this agrees with Labillardiere's description in which he refers to "quatre petales sont attachees au fond du calice". I have examined black and white photographs of five sheets in herb. FI which contain specimens determined by Labillardiere as *Mazeutoxeron rufum*. These specimens are largely vegetative. However, one specimen has a flower bud attached and this specimen appears to be *C. backhouseana*. It is therefore likely that the type material of *M. rufum* contains specimens of *C. alba* and of *C. backhouseana*. To determine which specimen agrees with which name requires an examination of the actual material which has not, however, been available. I have therefore not lectotypified the name *M. rufum* but have synonymized it in the manner of De Candolle (1824) and of Bentham (1863).

**Correa backhouseana** Hook., J. Bot. (Hooker) 1: 253 (1834) as *C. Backhousiana*.

*Notes*. The specific epithet was originally spelt *backhousiana*, however, the International Code of Botanical Nomenclature (Tokyo Code), 1994, indicates that the correct spelling should be *backhouseana* (Recommendation 60C).

Three varieties are recognized:

- 1 Corolla cream-coloured
- 2 Leaves ovate, sometimes slightly scabridulous above ..... **b. var. coriacea**
- 2: Leaves ovate to broadly ovate or broadly elliptic, smooth above ..... **a. var. backhouseana**
- 1: Corolla red with yellowish tips to lobes
- 3 Leaves ovate ..... **b. var. coriacea**
- 3: Leaves broadly ovate to circular ..... **c. var. orbicularis**

**a. *Correa backhouseana* Hook. var. *backhouseana***

*Distribution*. Occurs in coastal Tasmania, the Bass Strait islands, and in south-eastern coastal Victoria.

*Habitat*. Usually growing on coastal dunes and among rocks.

**b. *Correa backhouseana* var. *coriacea* (Paul G. Wilson) Paul G. Wilson, *comb. nov.***

*Correa reflexa* var. *coriacea* Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 30 (1961). *Type*: North Pearson Island, South Australia, 14 February 1960, *R.L. Specht* 2102 (*holo*: AD).



*Distribution.* Occurs in southern South Australia from the Mt Lofty Ranges westwards, and in south-eastern Western Australia along the Great Australian Bight.

*Habitat.* Growing on dunes and granite outcrops in South Australia while in Western Australia it is found on the limestone escarpment that borders the Bight.

*Notes.* On chemical and morphological grounds this variety was considered by Anderson (1986) to be most closely related to *C. glabra*. However, while there is a marked resemblance between the variant of *C. glabra* var. *turnbullii* found in the Murray lands of South Australia and the mainland variant of var. *coriacea*, overall the latter is most similar to *C. backhouseana* var. *backhouseana*, which similarity is reflected in the present taxonomy.

**c. *Correa backhouseana* var. *orbicularis* Paul G. Wilson, var. nov.**

[*C. rubra* var. *orbicularis* J. Black, *nom. inval.*, Fl. South Australia 2nd edn, 496 (1948)].

Folia late ovata vel circularia, plerumque 1-1.5 cm longa, coriacea, supra laevia, glabra, infra dense tomentosa cum pilis minutis. Flores terminales nec bracteoidei. Calyx hemisphaericus, truncatus, ferrugineo-tomentosus. Corolla cylindracea, 2-7 cm longa, tubo rubro, lobis flavidis.

*Typus:* Mt Thisby, Kangaroo Island, South Australia, 30 December 1965, Hj. Eichler 18565 (*holo:* AD).

Erect *shrub* c. 1 m high. *Leaves* broadly ovate to circular, mostly 1-1.5 cm long, coriaceous, smooth and glabrous above, densely tomentose with minute hairs beneath. *Flowers* solitary and terminal to short branchlets, the terminal leaves not modified to form bracts. *Calyx* hemispherical, c. 3 mm high, closely rusty-tomentose; margin truncate. *Corolla* cylindrical, in all 2-3 cm long, red with yellowish lobes. *Anthers* well exerted, narrowly oblong or narrowing towards apex.

*Selected specimens examined.* SOUTH AUSTRALIA, Kangaroo Island: Flinders Chase National Park, E.N.S. Jackson 4395 (AD); Dudley Peninsula, B. Overton 16030 (AD); Seal Bay, R.D. Spencer 1033 (MEL); Pennington Bay, D.E. Symon 8498 (AD); Karatta, 24 Jan. 1883, R. Tate (AD).

*Distribution.* Endemic to Kangaroo Island, South Australia.

*Habitat.* Growing in coastal heath in sand, often over limestone.

*Conservation status.* Apparently widespread on Kangaroo Island including Flinders Chase National Park.

*Etymology.* The varietal epithet *orbicularis* is Latin for circular and refers to the leaf shape. It was originally applied by J.M. Black to specimens from Kangaroo Island, but not validly published.

*Notes.* This variety hybridizes with *C. reflexa* var. *insularis* and many collections are somewhat intermediate between the two taxa. The anthers are in some specimens narrowly triangular which suggests introgression with *C. reflexa*, although in leaf morphology and in indumentum var. *orbicularis* is closer to *C. backhouseana*.

***Correa calycina*** J.M. Black, Trans. & Proc. Roy. Soc. South Australia 49: 273 (1925).

*Distribution.* Occurs in a few isolated localities in southern Fleurieu Peninsula, and on Kangaroo Island, South Australia.

*Habitat.* Usually growing on or near banks of streams.

*Notes.* The Kangaroo Island population differs significantly from those of the mainland and is described here as a new variety. The two varieties may be distinguished as follows:

Leaves sparsely to moderately densely stellate-hairy below ..... **a. var. *calycina***  
 Leaves densely stellate-hairy below ..... **b. var. *halmaturorum***

**a. *Correa calycina*** J.M. Black var. *calycina*

*Distribution.* Occurs in a few isolated localities in southern Fleurieu Peninsula, South Australia.

**b. *Correa calycina*** var. *halmaturorum* Paul G. Wilson, var. *nov.*

Ramuli valde ferrugineo flocculosi. Folia oblongo-elliptica, plerumque 2-4 cm longa, marginibus leviter recurva, supra scabridula, infra dense hinnuleo- vel ferrugineo-stellata. Calycis lobi lanceolato-acuminati.

*Typus:* De Mole River, Kangaroo Island, South Australia, 13 August 1985, *G. Jackson* 1760 (*holo:* AD; *iso:* CANB, MEL).

*Branchlets* strongly rusty-flocculose. *Leaf lamina* oblong-elliptic, the margin slightly recurved, mostly 2-4 cm long, obtuse, scabridulous above, densely fawn- to rusty-stellate-hairy below. *Flowers* subsessile. *Calyx lobes* lanceolate-acuminate.

*Selected specimens examined.* SOUTH AUSTRALIA: De Mole River, *K. Clipstone* 852089 (AD); mouth of De Mole River, *B.M. Overton* 390 (AD).

*Distribution.* Recorded only from the De Mole River, Kangaroo Island, South Australia.

*Habitat.* Growing along river banks in deep damp soil overlying shale in *Eucalyptus cladocalyx* forest.

*Conservation status.* Possibly at risk since the variety is only known from a small area along one river.

*Etymology.* The varietal epithet is derived from the Greek word *halma*, a leap, and this evidently gave rise to *Halmaturus*, a name apparently first used by J.C.W. Illiger in 1811 for a genus of kangaroo-like marsupial. Later the epithet *halmaturorum* "of the kangaroos", was applied by F. Mueller to certain plants endemic to Kangaroo Island.

***Correa eburnea*** Paul G. Wilson, *sp. nov.*

Folia elliptica vel ovata, integra, plerumque 3-5 cm longa, chartacea, laevia, supra glabra in statu maturo, infra minute eburneo tomentosa, obtusa, basi rotundata vel leviter cordata. Bractea circularia vel cordata, 1.2-2 cm longa, ad cymam terminalem adpressam. Flores nutantes. Calyx cupulatus, undulatus et 4-dentatus vel lobis late triangularibus ad 1.5 mm longis ornatis, cremeo tomentosus. Corolla cylindracea, 18-25 mm longa, viridis.

*Typus*: Deep Creek Conservation Park, Fleurieu Peninsula, South Australia, 4 August 1991, *R.J. Bates* 25726 (*holo*: AD).

*Shrub* 1-4 m high. *Branches* slender and sometimes flexuose towards apex, closely rusty-tomentose. *Leaves* shortly petiolate; lamina elliptic to ovate, entire, mostly 3-5 cm long, papery, flat, smooth; sparsely pubescent above when young, glabrous at maturity, minutely cream-tomentose beneath, obtuse, rounded to slightly cordate at base. *Peduncles* axillary, slender, bearing a pair of terminal rounded to cordate bracts 1-2.5 cm long appressed to a 1-5-flowered cyme. *Flowers* nodding; pedicel c. 2 mm long, with a pair of small linear caducous bracteoles. *Calyx* cup-shaped, in all 4-7 mm high, undulate and 4-dentate or with broadly triangular lobes to 1.5 mm long, closely cream-tomentose outside, sparsely tomentose within at margin. *Corolla* cylindrical, 18-25 mm long, green with close green tomentum. *Anthers* shortly or prominently exserted, narrowly triangular, c. 3 mm long, margins slightly reflexed. (Figure 1)

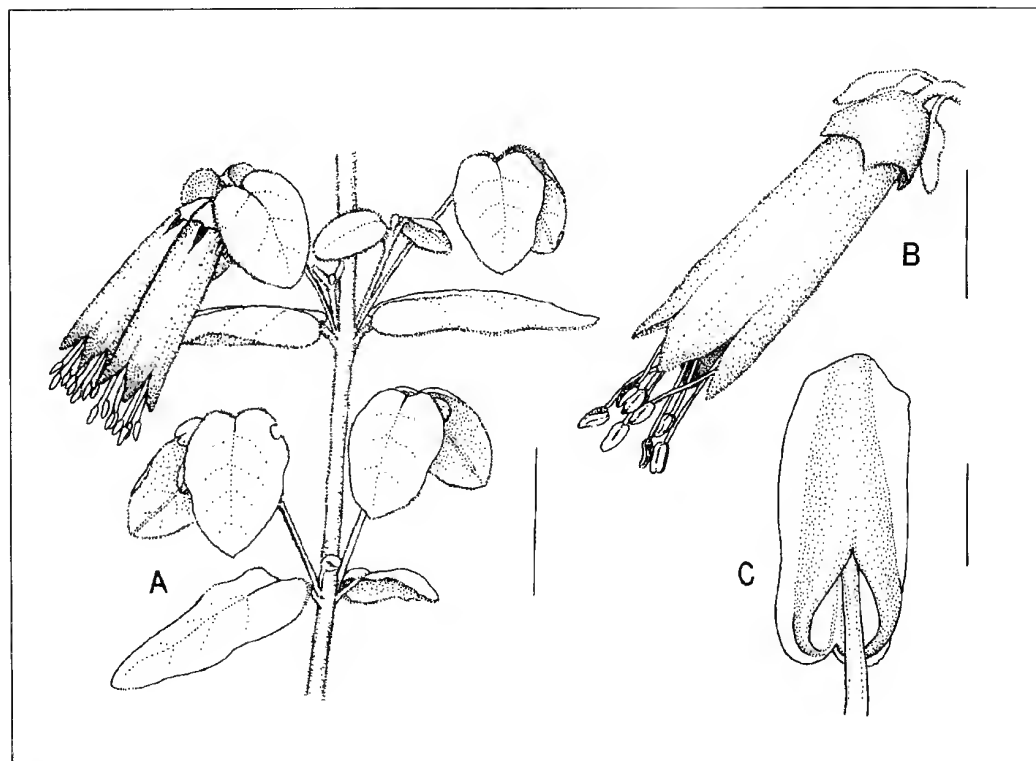


Figure 1. *Correa eburnea* A - flowering branch, B - flower, C - anther, abaxial view. Scale bars: A (20 mm), B (10 mm), C (1 mm). Drawn from *R.J. Bates* 25726.

*Selected specimens examined.* SOUTH AUSTRALIA: Deep Creek Conservation Park, *R.J. Bates* 25726 (AD); 2 miles [c. 3 km] from Goolwa, Jan. 1934, *J.B. Cleland* (AD); Boat Harbour Creek, *Hj. Eichler* 14426 (AD); Callawonga Creek, 25 Nov. 1953, *F.M. Hilton* (AD); E of Tunkalilla Creek, *D.N. Kraehenbuehl* 5249 (AD); Deep Creek area, *R. Schodde* 1139 (AD).

*Distribution.* Found at or near the south coast of Fleurieu Peninsula at Encounter Bay, South Australia.

*Habitat.* Where such information is provided, all collections except one are recorded as growing on banks of damp creeks.

*Conservation status.* This species is found over a small area, only one of the localities being in a Conservation Park. Therefore it is probably at risk.

*Etymology.* The epithet *eburnea* is derived from the Latin *eburneus*, meaning ivory-white, referring to the colour of the lower leaf surface.

*Notes.* This taxon was referred to *Correa reflexa* by Black (1924, 1948) and by Ashby (1939), but thought by Wilson (1961) to be possibly a hybrid between *C. calycina* and *C. reflexa*. Anderson (1986) also indicated that it probably had a hybrid origin and suggested a close relationship with *C. calycina*. The herbarium material referred to this species is somewhat variable in its floral features although all specimens obviously belong to the same taxon. The specimens show no sign of intergrading with any of the other species that are found in the Fleurieu Peninsula but they have the appearance of being somewhat distorted as though under stress or suffering from a disease, and this appearance may be due to the plant being a hybrid. Field work is obviously required to clarify the situation.

***Correa glabra*** Lindl. in T.L. Mitchell, Three Exped. E. Australia 2: 48 (1838).

*C. speciosa* race *glabra* (Lindl.) Benth., Fl. Austral. 1: 355 (1863). - *C. speciosa* var. *glabra* (Lindl.) Maiden & Betche, Census New South Wales Pl. 117 (1916). - *C. rubra* var. *glabra* (Lindl.) J. Black, Fl. South Australia 340 (1924). - *C. reflexa* var. *glabra* (Lindl.) Court, Victorian Naturalist 73: 175 (1957). *Type:* Near Hillston, New South Wales, 21 April 1836, *T.L. Mitchell* 84 (*holo:* CGE; *?iso:* MEL).

*Distribution.* Found in south-eastern Queensland, New South Wales, and western Victoria, westwards to Fleurieu Peninsula in South Australia.

*Notes.* The presumed isotype of *C. glabra* in herb. MEL, which is mounted on the same sheet as, and is almost identical to, that of the presumed isotype of *C. leucoclada*, has the lower surface of leaves tomentose while the holotype (CGE) has almost glabrous leaves.

Three varieties are recognized but these are not always clearly distinguishable since they grade into each other.

- 1 Flowers pale green or yellow
- 2 Leaves glabrous or glabrescent; calyx hemispherical, glabrous  
or glabrescent ..... **a. var. *glabra***
- 2 Leaves tomentose below; calyx cup-shaped to shortly cylindrical,  
tomentose ..... **b. var. *leucoclada***
- 1 Flowers red with green lobes ..... **c. var. *turnbullii***

**a. *Correa glabra* Lindl. var. *glabra***

*Distribution.* Found in south-eastern Queensland, New South Wales, and central and western Victoria.

*Habitat.* Growing principally in rocky habitats and along watercourses.

*Notes.* A widespread and polymorphic taxon that in places hybridizes with varieties of *C. reflexa*.

The plant found in the Torrens Gorge of the Mt Lofty Range in South Australia, that is usually referred to this taxon, appears to be a hybrid between the local variants of var. *turnbullii* and var. *leucoclada*, both of which grow in the area.

**b. *Correa glabra* var. *leucoclada* (Lindl.) Paul G. Wilson, *comb. nov.***

*C. leucoclada* Lindl. in T.L. Mitchell, Three Exped. E. Australia 2: 39 (1838). - *C. speciosarace leucoclada* (Lindl.) Benth., Fl. Austral. 1: 355 (1863). - *C. speciosa* var. *leucoclada* (Lindl.) Maiden & Betche, Census New South Wales Pl. 117 (1916). *Type:* Summit of Goulburn Range [Ural Range], New South Wales, 29 April 1836, T.L. Mitchell 106 (*holo:* CGE; *?iso:* MEL).

[*C. rubra* var. *megacalyx* J. Black, *nom. inval.*, Fl. South Australia 2nd edn, 496 (1948)].

*Distribution.* Found in South Australia in the southern Mt Lofty Ranges and also in eastern and central New South Wales.

*Habitat.* Generally growing in hilly situations along banks of streams.

*Notes.* The holotype of *C. leucoclada* in herb. CGE is dated 29 April 1836 while the presumed isotype in MEL, which bears the same collector's number, is dated 27 April 1836. Mitchell, in the account of his expedition, records collecting the plant near the summit of the Goulburn Range [= Ural Range] whereas the isotype in MEL has the locality Macquarry Range [= Cocoparra Range].

**c. *Correa glabra* var. *turnbullii* (Ashby) Paul G. Wilson, *comb. nov.***

*C. turnbullii* Ashby, Proc. Linn. Soc. Lond. 151: 220 (1939). - *C. rubra* var. *turnbullii* (Ashby) J. Black, Fl. South Australia 2nd edn, 496 (1948). *Type:* Near Monarto South, South Australia, E. Ashby (*holo:* AD).

*C. schlehtendalii* Behr, Linnaea 20: 630 (1847). *Type:* "In steinigen Scrubgegenden" [Stony scrubland], South Australia, June-August, H. Behr 139 (*holo:* HAL).

*Distribution.* Found in South Australia in the rocky hills of the Mt Lofty and Flinders Ranges, the plains of the Murray Lands, and in the north-western portion of the south-eastern region.

*Notes.* Anderson (1986) indicated that the plant found in the Mt Lofty and Flinders Ranges is different from that found on the plains of south-eastern South Australia. He included the "ranges" plant under *C. glabra* and the "plains" plant under *C. schlehtendalii*, noting, however, that the latter species should be treated as a variety of *C. glabra*. The plant from south-eastern South Australia generally has relatively small leaves and small flowers with spreading corolla lobes, although in cultivation the leaves

and flowers are larger. The Mt Lofty Ranges plants have larger leaves and larger flowers with more cylindrical corollas. The Flinders Ranges plants most closely resemble those from the south-east. Since the total variation of the plants from the ranges encompasses that found on the plains it seems inappropriate to distinguish them taxonomically.

The name *C. schlechtendalii* is based on a specimen whose precise origin is uncertain, however, it most closely resembles the variant of var. *turnbullii* that is found in the Mt Lofty Ranges.

***Correa lawrenceana*** Hook., J. Bot. (Hooker) 1: 254 (1834) as *C. Lawrenciana*.

*Distribution.* Found in eastern New South Wales, Victoria, and Tasmania.

*Habitat.* Typically a montane species.

*Notes.* The original spelling of the specific epithet, *lawrenciana*, is corrected to *lawrenceana* in accordance with recommendation 60c of the International Code of Botanical Nomenclature (Tokyo Code) (1994).

I have not observed any collection of *C. lawrenceana* that is a hybrid with any other species of *Correa* although hybridization or intergradation between varieties of *C. lawrenceana* is common.

Seven varieties are recognized within *C. lawrenceana* but since most grade into each other their delineation is imprecise.

- 1 Leaves narrowly elliptic, 2-4 cm long, glabrous to thinly rusty-tomentose below; corolla green ..... **a. var. *lawrenceana***
- 1: Leaves broadly elliptic to broadly cordate, mostly cream- to rusty-tomentose below; corolla cream to green or red
- 2 Calyx glabrescent, green, 9-12 mm long including the lanceolate acuminate lobes of 3-4 mm ..... **h. var. *genoensis***
- 2: Calyx densely fawn- or rusty-tomentose; margin truncate to shortly undulate-lobed or with linear lobes
- 3 Leaves broadly ovate to cordate, rounded at base
- 4 Calyx 5-10 mm long; bracteoles subtending calyx ..... **g. var. *macrocalyx***
- 4: Calyx 4-7 mm long; bracteoles at base of pedicel
- 5 Calyx 4-5 mm long, undulate or dentate on margin ..... **f. var. *cordifolia***
- 5: Calyx 4-7 mm long, with prominent linear lobes ..... **b. var. *latrobeana***
- 3: Leaves elliptic or ovate, cuneate at base
- 6 Calyx shallowly hemispherical, c. 2 mm high, sparsely to moderately densely stellate-hairy; corolla green ..... **e. var. *glandulifera***
- 6: Calyx hemispherical to cup-shaped, 3-7 mm high, densely tomentose; corolla green to cream or red
- 7 Leaves coriaceous, to 4 cm long, velvety beneath; corolla broadly cylindrical, cream-velvety; calyx robust, deeply cup-shaped, 5-7 mm long, rusty-tomentose ..... **d. var. *grampiana***

- 7: Leaves papery, to 9 cm long, tomentose beneath; corolla cylindrical, cream to red; calyx 3-7 mm high
- 8: Leaves narrowly elliptic, 4-6 cm long; peduncle and pedicel slender; corolla red ..... **c. var. rosea**
- 8: Leaves elliptic to broadly elliptic, 4-9 cm long; peduncle and pedicel short and thick; corolla yellowish green (rarely reddish) ..... **b. var. latrobeana**

**a. *Correa lawrenceana* Hook. var. *lawrenceana***

*C. lawrenceana* var. *glabra* Hook. f., *nom. illeg.*, Fl. Tasm. 1: 62 (1855), including the type of *C. lawrenceana*.

*C. ferruginea* Backh. in J. Ross, Hobart Town Alm. & Van Diemen Land Ann. 80 (1835). *Type*: Mt Wellington, Tasmania, *J. Backhouse (n.v.)*.

*C. ferruginea* Gunn ex Hook., *nom. illeg.*, Comp. Bot. Mag. 1: 276 (1836), later homonym. - *C. lawrenceana* var. *ferruginea* Hook. f., Fl. Tasmania 1: 62 (1855). *Type*: Hobart Town, Tasmania, R. Gunn 557 [=457] (*holo*: K, *Gunn*457).

*Distribution*. Found in Tasmania, including King Island, Bass Strait.

*Habitat*. Found principally in montane forest.

*Note*. The type of *C. lawrenceana* has almost glabrous leaves while the type of *C. ferruginea* is described as having leaves that are rusty-tomentose beneath which is the more widespread condition in Tasmania.

**b. *Correa lawrenceana* var. *latrobeana* (F. Muell. ex Hannaford) Paul G. Wilson, *stat. nov.***

*C. latrobeana* F. Muell. ex Hannaford, Jottings in Australia 40 (1856). *Type*: Delatite River, Victoria, 20 March 1853, *F. Mueller (lecto: MEL)*, *fide* P.G. Wilson (1961).

*Distribution*. Occurs in eastern Victoria and the Southern Tablelands of New South Wales.

*Habitat*. Usually found growing in open eucalypt forest.

*Notes*. This variety encompasses several intergrading variants, it is therefore to be distinguished more by the absence of those features that characterize the other varieties than in the possession of any particular attribute of its own. A variant found in the Otway Range, Victoria, is stated to take the form of a tree to 16 m high (Floyd 1989), while in the mountains of East Gippsland is found a shrubby red-flowered variant which has large densely flocculose calyces and prominent linear calyx lobes.

**c. *Correa lawrenceana* var. *rosea* Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 48 (1961).** *Type*: Geehi River, Alpine Way, New South Wales, 10 April 1958, *J. Vickery (holo: NSW 51508)*.

*Distribution*. Occurs in the Snowy Mountains of New South Wales.

*Habitat*. Usually found in wet sclerophyll forest.

*Notes.* This variety grades into the alpine element of var. *latrobeana*. It may be recognized by its narrowly elliptic leaves, narrow red flowers, slender peduncles, and slender pedicels that have minute caducous bracteoles.

**d. *Correa lawrenceana* var. *grampiana*** Paul G. Wilson, *var. nov.*

Folia coriacea, elliptica, obtusa, plerumque 2-4 cm longa, 1-1.7 cm lata, supra glabra, infra pilis hinnulcis velutinosi. Flores solitarii; pedunculus recurvatus, 2-5 mm longus; pedicellus c. 6 mm longus. Calyx validus, profunde cupulatus, 5-7 mm longus, ferruginoso tomentosus, manifeste undulatus vel 4-dentatus. Corolla late cylindracea, 15-25 mm longa, tomento luteo-brunneo velutinosi.

*Typus:* Saddle c. 0.8 km south-south-east of summit of Mt William, Victoria, 8 September 1986, D.E. Albrecht 2774 (*holo:* MEL).

*Shrub* to 2.5 m high. *Leaves* coriaceous, elliptic, obtuse, mostly 2-4 cm long, 1-1.7 cm wide, glabrous above, velvety below with fawn-coloured hairs. *Flowers* solitary, axillary; peduncle recurved, 2-5 mm long; pedicel c. 6 mm long, medially bracteolate with small (c. 2 mm long) caducous filamentous bracteoles. *Calyx* robust, deeply cup-shaped, 5-7 mm long, ferruginous-tomentose, prominently undulate or 4-dentate on margin. *Corolla* broadly cylindrical, 15-25 mm long, velvety with thick cream to yellow-brown tomentum.

*Selected specimens examined.* VICTORIA: Mt William, The Grampians, B.G. Briggs 2889 (NSW); Mt Langi Ghiran, 9.5 miles [c. 15 km] E of Ararat, 14 Apr. 1970, A.E. Millar (MEL); Mt Rosea, The Grampians, 13 Sep. 1961, M.E. Phillips (CANB); Major Mitchell Plateau, The Grampians, 8 Dec. 1962, J.H. Willis (MEL).

*Distribution.* Occurs in western Victoria in The Grampians and on Mt Langi Ghiran, c. 15 km east of Ararat.

*Habitat.* A montane plant growing among rocks.

*Etymology.* The varietal epithet refers to the principal area of distribution, The Grampians of Victoria.

*Notes.* The small thick coriaceous leaves and the broadly cylindrical corolla with a velvety indumentum make this a distinctive variety. Presumably due to its isolation it does not grade into any other variety.

**e. *Correa lawrenceana* var. *glandulifera*** Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 49 (1961). *Type:* Springbrook, Queensland, 21 September 1929, C.T. White 6274 (*holo:* BRI).

*Distribution.* Occurs in the mountains near the north coast of New South Wales and in the Macpherson Range of far south-eastern Queensland.

*Habitat.* Recorded as growing on the margin of rainforest.

**f. *Correa lawrenceana* var. *cordifolia*** Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 47 (1961). *Type:* Mt Dromedary, New South Wales, E.F. Constable (*holo:* NSW 26186).

*Distribution.* Found near the south coast of New South Wales inland to near Braidwood and the far east of Victoria.



*Habitat.* Recorded as often growing along creeks in rainforest.

**g. *Correa lawrenceana* var. *macrocalyx*** (Blakely) Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 48 (1961). - *C. macrocalyx* Blakely, Proc. Linn. Soc. New South Wales 54: 681 (1929). *Type:* Patonga Creek, New South Wales, October 1923, *D.W.G. Shiress & W.F. Blakely (holo: NSW)*.

*Distribution.* Found in the Taree-Kendle area of eastern New South Wales.

*Habitat.* Usually recorded as growing on the margin of montane rainforest.

**h. *Correa lawrenceana* var. *genoensis*** Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 50 (1961). *Type:* Genoa River, Victoria, September 1860, *F. Mueller (holo: MEL)*.

*Distribution.* Found along the Genoa River, eastern Victoria.

*Habitat.* A strictly riparian plant.

***Correa reflexa*** (Labill.) Vent., Jard. Malm. 1: sub t. 13 (1803). - *Mazeutoxeron reflexum* Labill., Voy. Rech. Perouse 2: 66 (1800). *Type:* "La baie de l'Aventure" [Adventure Bay], Tasmania, February 1793, *J.J.H. de Labillardiere (n.v.)*.

*Notes.* A very variable species. Seven varieties are here recognized but these cannot easily be delineated as each grades into one or more of the other varieties and each hybridizes with those *Correa* species with which it comes in contact.

In preparing the following treatment I have been influenced by Anderson (1983) who indicated that the typically red-flowered plants differ chemically from those that are typically green-flowered. In practice the separation is far from clear and the distinction between var. *reflexa* and var. *speciosa* is in many cases difficult to discern, possibly due to hybridization between the two varieties. In addition, each of these varieties contains local variants which from their morphological characters alone could be recognized as discrete taxa. The difficulties are compounded by apparent hybrid swarms that cover large areas and which may themselves warrant nomenclatural recognition.

- 1 Corolla green to yellow
  - 2 Calyx with four deeply triangular lobes ..... **b. var. lobata**
  - 2: Calyx truncate or dentate
    - 3 Flowers drooping, clasped between two reflexed foliaceous bracts ..... **a. var. reflexa**
    - 3: Flowers erect to drooping, not obviously clasped by foliaceous bracts
      - 4 Calyx rusty-tomentose; anthers scarcely exerted ..... **g. var. nummulariifolia**
      - 4: Calyx fawn-tomentose; anthers prominently exerted ..... **f. var. insularis**
- 1: Corolla red with green or pale lobes
  - 5 Leaves narrowly oblong; calyx 4-dentate and with 4 broadly triangular lobes ..... **e. var. angustifolia**
  - 5: Leaves narrowly to broadly ovate or cordate; calyx truncate or 4-dentate
    - 6 Flowers drooping, clasped between two reflexed foliaceous bracts ..... **a. var. reflexa**
    - 6: Flowers erect to drooping, not clasped between reflexed foliaceous bracts

- 7 Corolla broadly cylindrical or swollen (New South Wales, eastern & central Victoria) ..... **c. var. speciosa**  
 7: Corolla trumpet-shaped (South Australia, western Victoria) ..... **d. var. scabridula**

**a. *Correa reflexa* (Labill.) Vent. var. *reflexa***

*Distribution.* Found in the mountains of south-east Queensland, eastern New South Wales, and eastern Victoria; and in the coastal and near coastal areas of southern New South Wales, Victoria, far south-east South Australia, and eastern Tasmania.

*Habitat.* Often growing in damp gullies and rainforest.

*Notes.* A variable taxon. On the north-east coast of Tasmania is found a variant with small leaves that are rounded at the base and almost glabrous beneath; it appears to grade to the north and south into typical var. *reflexa*. In east Gippsland, the Snowy Mountains, and in the Southern Tablelands of New South Wales the flowers are sometimes dull red and green and are broader than is usual in var. *reflexa*. On the north coast of Tasmania is found a variant with red and green flowers that otherwise differs little from the more widespread green-flowered plant.

In far south-western Victoria is found a variant with green flowers and with thin, sessile, cordate and dentate leaves that are sparsely pubescent beneath. It was on this variant that the name *C. cordifolia* was based. It intergrades with both var. *speciosa* and *C. alba* var. *pannosa*. The variant found in far south-eastern South Australia is a red-flowered plant that is intermediate in morphology between var. *scabridula* and the south-western Victorian variant of var. *reflexa*.

On the east side of Port Phillip Bay and near Port Campbell are found plants that appear to be derived from an introgression between var. *reflexa* and *C. alba* var. *alba*.

**b. *Correa reflexa* var. *lobata* Paul G. Wilson, var. nov.**

Folia chartacea, ovata, ad basim rotundata vel subcordata, plerumque 2-4.5 cm longa, crenulata, supra scabridula, infra hinnuleo stellata. Pedunculus gracilis; bractae foliaceae ad cymam appressam. Calyx obconicus, ad 16 mm longus, sparse stellatus, in lobos triangulares divisus in quarta vel dimidium parte superiore. Corolla anguste cylindracea, ad 35 mm longa, omnino pallido viridis.

*Typus:* Headwaters of Bunyip River, 10 km north-east of Gembrook, Victoria, 27 June 1959, T.B. Muir 774 (*holo:* MEL).

*Shrub* to 2 m high. *Leaves* papery, ovate, rounded or subcordate at base, mostly 2-4.5 cm long, crenulate on margin, scabridulous above, moderately densely fawn-stellate-hairy below. *Flowers* terminal to slender axillary peduncle, the terminal leaves clasping a cluster of flower buds. *Calyx* sparsely stellate-hairy, obconic, to 16 mm long, the upper quarter to half variably divided into triangular acuminate lobes, sometimes with short intermediate lobes. *Corolla* narrowly cylindrical, to 35 mm long, entirely yellow green. *Anthers* narrowly ovate, c. 3 mm long.

*Selected specimens examined.* VICTORIA: S of Avonsleigh, Dandenong Ranges, M.G. Corrick 5040 (MEL); 3 km W of Powelltown, D. Foreman 1037 (CANB); Gembrook, 16 Aug. 1917, E.H. Ising (AD); Cranbourne, J.H. Ross 2594 (MEL).

*Distribution.* Restricted to the Dandenong and Powelltown area of eastern Victoria.

*Habitat.* Recorded as growing in eucalypt forest and heathland in hilly terrain.

*Etymology.* The varietal epithet is derived from the Latin word *lobatus* which means lobed and refers to the prominent lobes of the calyx.

*Notes.* This variety is similar to var. *reflexa*, into which it grades. Var. *lobata* differs most noticeably from var. *reflexa* in having a deeply lobed calyx.

**c. *Correa reflexa* var. *speciosa* (Donn ex Andr.) Paul G. Wilson, *comb. nov.***

*Correa speciosa* Donn ex Andr., Bot. Rep. 10: t. 653 (1812). - *Antommarchia rubra* Colla ex Presl, *nom. illeg.*, Rep. Bot. Syst. 1: 185 (1834), based on preceding. - *Antommarchia speciosa* (Andr.) B.D. Jackson, *pro syn.*, *nom. inval.*, Index Kew. 1: 157 (1895). *Type:* Bot. Rep. 10: t. 653.

*Correa cardinalis* F. Muell. ex Hook., Bot Mag. 92: t. 4912 (1 Apr. 1856). - *C. speciosa* var. *cardinalis* (F. Muell. ex Hook.) J. Stirling, Proc. Linn. Soc. New South Wales 11: 1058 (1887). - *C. speciosa* f. *cardinalis* (F. Muell. ex Hook.) Siebert & Voss, Vilm. Blumengaertn. 3rd edn, 1: 170 (1896). - *C. reflexa* var. *cardinalis* (F. Muell. ex Hook.) Court, Victorian Naturalist 73: 175 (1957). *Type:* Bot. Mag. 92: t. 4912.

*Distribution.* Coastal New South Wales, south of Port Stephen, and south-east and central Victoria.

*Habitat.* Growing on coastal dunes, sand, or on sandstone in dry sclerophyll woodland.

*Notes.* The autonym *Correa speciosa* var. *speciosa* was established by the publication of *C. speciosa* var. *nummulariifolia* Hook. f. (1855) and therefore antedates the name *C. speciosa* var. *cardinalis* (Hook.) J. Stirling (1887). Since an autonym has priority over the name by which it was created, it would in any event have priority over var. *cardinalis* if the two were to be recognized as synonyms.

Near Ulladulla, New South Wales, is found a variant with a pale yellow corolla which appears to grade into the common red variant and which is possibly the result of an intergradation between var. *speciosa* and the green-flowered var. *reflexa* that is found further inland.

Near Sydney plants have been collected that appear to be intermediate between var. *reflexa* and var. *speciosa*. Hybrids with *C. alba* var. *alba* are found in many coastal areas. Var. *speciosa* also grades into *C. reflexa* var. *scabridula* wherever the two varieties grow near to each other.

**d. *Correa reflexa* var. *scabridula* Paul G. Wilson, *var. nov.***

Folia coriacea, ovata, c. 1.5 cm longa, ad basim rotundata vel leviter cordata, margine leviter recurva et irregulariter undulata, supra scabridula, infra ferrugineo-stellata. Calyx hemisphericus, laxe tomentosa pilis rubiginosis. Corolla buccinata, 1.5-2(3) cm longa, rubra vel aurantiaca lobis pallidioribus.

*Typus:* Coorong Road near Salt Creek, c. 60 km SSE of Meningie, South Australia, 4 May 1958, D.J.E. Whibley 193 (*holo:* AD).

Erect or spreading *shrub* to 0.5 m high. *Lamina* coriaceous, ovate, *c.* 1.5 cm long, rounded to slightly cordate at base, somewhat recurved and irregularly undulate on margin, scabridulous above, moderately densely rusty-stellate-hairy below; petiole 2-3 mm long. *Calyx* hemispherical, loosely stellate-tomentose with rusty hairs. *Corolla* trumpet-shaped, 1.5-2(3) cm long, red to orange with paler lobes. *Anthers* shortly exserted, narrowly oblong, rounded at apex.

*Selected specimens examined.* SOUTH AUSTRALIA: 4 km NE of MacLaren Flat, *A.W. Bell* 200 (AD); Mt Boothby Conservation Park, *E.N.S. Jackson* 5699 (AD); 3 km NW of Coomandook, *M.C.R. Sharrad* 958 (AD).

VICTORIA: Little Desert, *M.G. Corrick* 6281 (MEL); road to Flat Rock, near Mt Zero, The Grampians, 19 Mar. 1961, *M.E. Phillips* (CANB).

*Distribution.* Found from the Mt Lofty Ranges in South Australia to eastern Victoria.

*Habitat.* Generally growing as an understorey in mallee heathland.

*Etymology.* The varietal epithet is derived from the Latin word *scabridulus*, which is the diminutive of *scabridus* and means minutely scabrid, referring to the upper surface of the leaves.

*Notes.* In South Australia this variety hybridizes with *C. glabra* var. *turnbullii* while in The Grampians of Victoria it hybridizes with *C. reflexa* var. *angustifolia*. In Victoria it grades eastwards into var. *speciosa* and collections from the intermediate zone cannot be precisely determined. In far south-west Victoria it forms introgressive populations involving both var. *reflexa* and *C. alba*. These populations were treated as a variant of var. *reflexa* by Wilson (1961) and by Anderson (1986) although in both cases with reservations.

**e. *Correa reflexa* var. *angustifolia*** Paul G. Wilson, *var. nov.*

*Folia* anguste oblonga, 15-30 mm longa, obtusa, leviter recurva, supra scabridula, infra dense ferrugineo flocculosa. *Calyx* late obconicus vel campanulatus, breviter 8-lobatus (lobis sepalinis linearibus ad 1.5 mm longis, lobis petalinis triangularibus ad 1 mm longis), ferrugineo tomentosus, *c.* 5 mm altus ad basim loborum. *Corolla* cylindracea, 3-4 cm longa, rubra, lobis viridibus.

*Typus:* Victoria Range, The Grampians, Victoria, 23 February 1957, *M.M. & P.E. Finck & A.C. Beaglehole* ACB 4038 (*holo:* MEL; *iso:* MEL).

*Shrub* to 1 m high. *Leaves* narrowly oblong, 15-30 mm long, obtuse, somewhat recurved, scabrid above, densely rusty-flocculose below. *Calyx* broadly obconic or bell-shaped, shortly 8-lobed (sepaline lobes linear, to 1.5 mm long; petaline lobes triangular, to 1 mm long), with loose rusty tomentum, *c.* 5 mm high to base of lobes, sometimes slightly folded towards margin. *Corolla* cylindrical, 3-4 cm long, red with pale green lobes. *Anthers* obtuse.

*Selected specimens examined.* VICTORIA: Redmans Gap, The Grampians, *D.E. Albrecht* 3167 (MEL); Silverband Road, The Grampians, 23 Mar. 1961, *M.E. Phillips* (CANB); Cultivation Creek, Victoria Range, *H. Streimann* 2960 (PERTH); Barneys Creek, Mt William Range, 30 Sep. 1959, *J.H. Willis* (MEL).

*Distribution.* Found principally in the Victoria Range and the Mt William Range in The Grampians, Victoria.

*Habitat.* Often growing on sandstone slopes in stringy bark (*Eucalyptus viminalis*) woodland.

*Conservation status.* This variety occurs principally in a national park where its security is ensured.

*Etymology.* The varietal epithet is derived from the Latin *angustus*, narrow, and *folium*, leaf, referring to the narrow leaves.

*Notes.* This variety may be recognized by its narrow leaves which are recurved on their margins and densely flocculose beneath, its 8-lobed calyces, and its large red corollas. Although treated here as a variety of *C. reflexa*, it has the appearance of being a hybrid between *C. decumbens* and a red-flowered variety of *C. reflexa*; however, *C. decumbens* is not known to occur in Victoria.

This variety intergrades with *C. reflexa* var. *speciosa*. Hybridization also occurs in The Grampians wherever *C. reflexa* var. *angustifolia* and *C. aemula* grow next to each other.

**f. *Correa reflexa* var. *insularis*** Paul G. Wilson, *var. nov.*

Folia late ovata vel circularia, plerumque 1.5-2 cm longa, plana, obtusa, ad basim rotundata, supra minute scabridula, infra tomentosa pilis manifestis. Bracteis foliaribus nec manifestis. Calyx tenuis, cupulatus, 3-4 mm longus, truncatus et breviter 4-dentatus, hinnuleo-tomentosus. Corolla anguste cylindracea, c. 2 cm longa, luteoviridis ad apicem ferruginea, versus basim sparse stellata. Anthera manifeste exserta.

*Typus:* Section 36, Hundred of Haines, Kangaroo Island, South Australia, 23 May 1989, *P.J. Lang* 8544 (*holo:* AD).

Erect *shrub* to 2 m high. *Leaves* broadly ovate to circular, mostly 1.5-2 cm long, flat, rounded at base, obtuse, upper surface minutely stellate-scabridulous, lower surface tomentose with obvious stellate hairs; petiole c. 4 mm long. *Flowers* terminal to branches, not surrounded by obvious leafy bracts. *Calyx* thin, cup-shaped, 3-4 mm long, truncate and shortly 4-dentate, fawn-tomentose. *Corolla* narrowly cylindrical, c. 2 cm long, yellowish green with rusty tip, moderately densely stellate-hairy towards apex but sparsely so towards base. *Anthers* well-exserted, narrowly oblong and narrowed towards an obtuse apex.

*Selected specimens examined.* SOUTH AUSTRALIA, Kangaroo Island: Nepean Esplanade, *M. Hart* 1 (CANB); Dudley Conservation Park, *G. Jackson* 2004 (AD); Birchmore Road, *I. Jackson* 3105 (CANB); 1 km N of Flour Cask Bay, 20 June 1986, *D.N. Kraehenbuhl* (CANB); Ayliffe Hill, *B.M. Overton* 09 (MEL).

*Distribution.* Endemic to the eastern half of Kangaroo Island, South Australia.

*Habitat.* Found in mallee scrub on a variety of soils including ironstone and sand.

*Etymology.* The Latin epithet *insularis* refers to the fact that the variety is found only on an island.

*Notes.* This variety hybridizes with *C. decumbens* and with *C. backhouseana* var. *orbicularis*. It is similar to *C. reflexa* var. *nummulariifolia* from the Bass Strait islands with which it was confused by Wilson (1961). In the latter variety the anthers are enclosed or just exserted and the calyx is hemispherical and densely rusty-tomentose.

**g. *Correa reflexa* var. *nummulariifolia*** (Hook. f.) Paul G. Wilson, Trans. Roy. Soc. South Australia 85: 30 (1961). - *C. speciosa* var. *nummulariifolia* Hook. f., Fl. Tasm. 1: 62 (1855). *Type*: Flinders Island, Bass Strait, Tasmania, 26 March 1844, J. Milligan per C. Gunn 1945b (*lecto*: K; *isolecto*: CANB, MEL), lectotype here chosen.

*Distribution.* Found in the islands of the Furneaux Group, Bass Strait, Tasmania.

*Habitat.* Found on mountains and on the coasts.

*Typification.* J.D. Hooker cited two collections under the name *C. speciosa* var. *nummulariifolia*; the first citation followed the Latin diagnosis and was simply “Gunn, 1945”, while the second citation, which he included in the paragraph on “Habitat”, was “Flinders’ Island, Backhouse”. The Backhouse collection could not be located in herb. K. The sheet in herb. K that bears the Gunn collection contains five plant pieces and three labels; the information on these labels is as follows:

1. (in Gunn’s handwriting) “1945. *Correa virens* vars/ 1945a, & 1945b, I believe to be mere varieties of the same species although from different localities and numbered separately by Dr. Milligan, who sent them to me from Flinders Island.”
2. “1945a/ Flinder’s Island & Gun Carriage Isld./ 30/8 & 28/10/44”.
3. “1945b/ Flinders’ Island/ Sea coast. 26/3/44”.

J.D. Hooker wrote the name “var. *nummulariaefolia*” against the number 1945b on labels 1 and 3. It therefore appears that he intended the accompanying specimen to be of this variety. The specimen that agrees best with the protologue is also the one nearest to label 3 on which Hooker has written the name “*nummulariaefolia*”; it is on the right-hand side of the sheet and is here designated the lectotype.

The numbers given to the specimens are those of Charles Gunn, not those of the collector, Joseph Milligan. A possible islectotype in herb. CANB bears an ex herb. BM label on which has been typed “Flinders Island. 26.iii.1844/ Joseph Milligan, 695”; another possible islectotype in herb. MEL has a label with the note “695, Flinders Island”; both the MEL and CANB specimens match the lectotype of var. *nummulariifolia*. The Kew sheet has been annotated by G. Bentham *C. speciosa* var. A with the species name underlined in red ink which indicates that Bentham had examined the sheet when preparing the “Flora Australiensis” (see Bentham 1863: 8\*) and that he considered the specimens to belong to the variety *C. speciosa* a. *normalis*.

*Notes.* Anderson (1986) stated that material of *C. reflexa* var. *nummulariifolia* from the Bass Strait islands is most closely related to *C. backhouseana*. However, in making this assertion he was probably referring to the Bass Strait variant of *C. backhouseana* var. *backhouseana* with which taxon it has been confused.

This taxon, although here treated as a variety, may be a member of a hybrid complex involving *C. backhouseana*, *C. alba* and *C. reflexa* var. *reflexa*, and therefore few collections precisely match the type. A similar plant is found on the east coast of Tasmania where a hybrid origin is apparent.

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## *Diplolaena* (Rutaceae), new taxa and nomenclatural notes

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### Abstract

Paul G. Wilson, J.A. Armstrong and E.A. Griffin. *Diplolaena* (Rutaceae), new taxa and nomenclatural notes. Nuytsia 12 (1): 107-118 (1998). In preparation for an account of *Diplolaena* in "Flora of Australia" nomenclatural and taxonomic notes are presented. Seven new species are described: *D. cinerea* Paul G. Wilson, *D. eneabensis*, *D. geraldtonensis*, *D. graniticola*, *D. leemaniana*, *D. mollis* and *D. obovata*. One new combination is made: *D. velutina* (Paul G. Wilson) Paul G. Wilson. A key to species is provided.

### Introduction

A treatment of *Diplolaena* (Rutaceae) has been prepared for Volume 26 of the "Flora of Australia" and this paper is a precursor to it. The genus is endemic to south-west Western Australia. It has long been a problem to taxonomists, partly because of the lack of suitable characters for use in discriminating the taxa and partly because of the apparent merging of one species into another. A further difficulty lies in the uncertain application of some of the names that have been applied to the species.

Bentham (1863) recognized four species and one variety in *Diplolaena* but he observed that when better known the species might be found to "run too much into one another to be otherwise separated than as marked varieties". In making this observation he may have been influenced by Ferdinand Mueller who had annotated material he had sent to Bentham as varieties of *D. dampieri*. Some years later Mueller (1875) still recognized only *D. dampieri* in the genus and indicated that he was not able to discriminate the other species that had been distinguished by Bentham.

The conclusions reached by Mueller were supported by Diels & Pritzel (1904). However, Ostenfeld (1921) recognized the taxa listed by Bentham, but gave them a somewhat different circumscription; he also described an additional species, *D. andrewsii*.

Over the past seventy years, and particularly over the past twenty, there has been much additional collecting of *Diplolaena* material which has made possible a reassessment of its taxonomy. It is now apparent that 15 species can be recognized. Of these, five are fairly clearly demarcated, i.e. *D. andrewsii*, *D. angustifolia*, *D. dampieri*, *D. grandiflora*, and *D. obovata*. The remaining ten species exhibit

considerable variability. This variability, it would appear, is largely due to introgression between neighbouring species. Such introgression often characterizes bird-pollinated genera, with *Diplolaena* being one of the most spectacular examples of the syndrome in Rutaceae (Armstrong 1979, 1987).

As noted above, a difficulty encountered when classifying the *Diplolaena* taxa is the lack of clearly definable characters with which to discriminate them. The characters that are most useful are found in the leaves - their shape, size, texture, and indumentum - but not all of these characters are easy to define. Ostenfeld (1921) provided a key that relied heavily on hair type and abundance; however, as is apparent from his citation of specimens, Ostenfeld had what can now be seen to be a confused understanding of some taxa. The shape and indumentum of the outer involucral bracts is also useful in discriminating the taxa, but these characters are variable, even on involucre from the same plant, while the hairs themselves may be lost with age.

### New taxa and taxonomic notes

***Diplolaena*** R. Br. in Flinders, Voy. Terra Austr. 2: 546 (1814).

*Type: Diplolaena dampiera* Desf., lectotype here chosen.

*Lectotypification.* Robert Brown (1814), who described the genus *Diplolaena*, stated that he based his description on specimens gathered at Shark Bay on the expeditions of William Dampier and of Baudin. Dampier visited Shark Bay in 1699 and Baudin in 1801.

From an examination of photographs of the material present in herb. BM and herb. OXF it is apparent that Brown studied specimens from Geographe Bay collected by J.B.L.T. Leschenault de la Tour, a botanist on the Baudin expedition, as well as specimens from Shark Bay collected by Leschenault and Dampier. Evidently Leschenault confused his collecting localities and assigned his Geographe Bay collections of *Diplolaena* to Shark Bay (see also Desfontaine (1817) and Ostenfeld (1921)).

Brown's description was brief and informal: "I have ascertained that what appears to be calyx and corolla in this singular plant, are in fact a double Involucrum containing many decandrous flowers, whose Stamina and Pistilla exactly agree with those of the order, but of which the proper floral envelopes are reduced to a few irregularly placed scales". No species name was applied by Brown but it would appear that he assumed the material that he studied to be conspecific.

A photograph has been examined of the *Diplolaena* collection in herb. OXF that was gathered by W. Dampier at Shark Bay; it is of *D. grandiflora*. Photographs of three sheets of *Diplolaena* in herb. BM which contain material collected on the Baudin expedition have also been examined; all these sheets were presumably examined by Brown. They are as follows:

Sheet 1. This contains material collected on the Baudin expedition and material collected on an expedition under the command of Capt. King. There are neither locality details nor dates. All the specimens on this sheet are of *D. grandiflora* Desf.

Sheet 2. This sheet has a description of the plant attached to it and the locality data "cote ouest de la Nlle hollande iles de dorres Baie des chiens Marins 1801". Both the note and the description are apparently in Leschenault's handwriting. The sheet has been annotated "*Diplolaena grandiflora*

Desfont. in Mem. Mus. 3, p. 449. t. 19. Sharks Bay. M. Lechenault". The specimens on the sheet are all of *D. grandiflora* and are presumably isotypes of that name.

Sheet 3. This sheet has in Leschenault's handwriting the locality data "cote ouest de la Nlle hollande iles de dorres Baie deschiens marins 1801". It has been annotated "Diplolaena dampieri Desfont. Mem. Mus. 3. t. 20 exclud. syn. Dampieri quod ad praecedentem pertinet / Sharks bay. M. Leschenault". The note presumably refers to the comment by Desfontaines that the plant is the same as that mentioned by Dampier in "Terres Australes, vol.v, page 141, tab. 3, fig. 3, edit. francaise" which, of course, it is not. The three specimens on this sheet have been correctly identified and are presumably isotypes of *D. dampieri* Desf. Since this coastal species is only found on the south-west coast of Western Australia as far north as Perth it was presumably collected by Leschenault at Geographe Bay (the only south-west locality visited).

In order to be consistent with the typification given in recent literature we are lectotypifying the name *Diplolaena* on the lower right hand specimen of Sheet 3. The name of the lectotype of the genus therefore becomes *D. dampieri* which is the name indicated (prematurely) as type in Farr *et al.* (1979), in Chapman (1991), and in Greuter *et al.* (1993). This is in spite of the fact that the greater part of the material examined by Brown was of *D. grandiflora*. Since the two species are undoubtedly congeneric the choice of either species as lectotype makes no difference to the application of the name *Diplolaena*.

### Key to species

- 1 Leaves linear to narrowly oblong, 2-6 cm long; margin recurved to revolute; inner involucre bracts 15-20 mm long (Wanneroo to Eneabba) ..... **D. angustifolia**
- 1: Leaves variously shaped but not linear, 1-6 cm long; margin if recurved then inner involucre bracts less than 12 mm long
- 2 Leaves elliptic to broadly elliptic, glabrous above when mature, densely tomentose below with a close pale indumentum, somewhat leathery
- 3 Outer involucre bracts broadly ovate, inner bracts ± equal to stamens (Geraldton to North West Cape) ..... **D. grandiflora**
- 3: Outer involucre bracts triangular to narrowly triangular, inner bracts much shorter than stamens
- 4 Leaves with a dense indumentum of minute stellate hairs; involucre bracts with a grey indumentum (Cape Leeuwin to Fremantle) ..... **D. dampieri**
- 4: Leaves with a dense indumentum of well-defined stellate hairs; involucre bracts with a rusty indumentum (Hutt River to Dongara) ..... **D. geraldtonensis**
- 2: Leaves variously shaped, pubescent above or if glabrous then not densely tomentose below, papery to leathery
- 5 Leaves sparsely stellate-pubescent above and below
- 6 Inner involucre bracts glabrous; leaves broadly cordate [1.5-4 cm long] (Darling Range near Perth) ..... **D. andrewsii**
- 6: Inner involucre bracts pubescent; leaves rounded to cuneate at base
- 7 Leaves obovate to broadly obovate, c. 1 cm long; involucre bracts rusty-pubescent (Green Head to Lancelin) ..... **D. obovata**
- 7: Leaves oblong-elliptic, mostly over 3 cm long, very thin, involucre bracts grey-pubescent (Darling Range) ..... **D. drummondii**

- 5: Leaves moderately to densely stellate-pubescent below, sparsely to densely so above
- 8 Leaves narrowly oblong-cuneate, 3-5 mm wide, often conduplicate; margin flat or slightly recurved (Coorow to Kondinin) ..... **D. velutina**
- 8: Leaves oblong to broadly elliptic, broadly obovate or circular, flat or rarely slightly conduplicate; margin not recurved
- 9 Leaves broadly elliptic to broadly obovate, to 2 cm long, firm, very densely tomentose above and below (Shark Bay to Kalbarri)..... **D. mollis**
- 9: Leaves variously shaped, sparsely to moderately densely pubescent above
- 10 Leaves sparsely to moderately densely pubescent below
- 11 Leaves broadly oblong-elliptic, mostly 2-6 cm long, thin (Darling Range) ..... **D. drummondii**
- 11: Leaves elliptic to broadly elliptic, to 2 cm long, herbaceous
- 12 Leaf-indumentum loose, hairs c. 0.7 mm diam.; outer involucre bracts rusty (Walpole to Esperance) ..... **D. microcephala**
- 12: Leaf-indumentum loose or dense, hairs c. 0.3 mm diam.; outer bracts fawn or rarely rusty (Darling Range to Collic) ..... **D. graniticola**
- 10: Leaves densely pubescent below
- 13 Outer and inner involucre bracts with rusty red indumentum
- 14 Outer bracts very narrowly triangular; leaves glabrous and bright green above, somewhat leathery (Mingenew to Dandaragan) ..... **D. ferruginea**
- 14: Outer bracts ovate; leaves soft, sparsely pubescent and dull green above, papery (Eneabba area) ..... **D. encabensis**
- 13: Outer and inner bracts green or with grey to pale red indumentum
- 15 Leaves almost glabrous above, oblong-elliptic, flat, somewhat leathery (Hutt River to Dongara)..... **D. geraldtonensis**
- 15: Leaves pubescent above, narrowly oblong to elliptic, broadly ovate, or broadly elliptic, papery
- 16 Outer bracts narrowly triangular to triangular; leaves narrowly oblong to oblong or elliptic, mostly 10-20 mm long, flat or folded, firm
- 17 Leaf-indumentum loose, hairs c. 0.7 mm diam.; outer involucre bracts rusty (Walpole to Esperance) ..... **D. microcephala**
- 17: Leaf-indumentum loose or moderately dense, hairs c. 0.3 mm diam.; outer involucre bracts fawn or rarely rusty (Darling Range to Collic) ..... **D. graniticola**
- 16: Outer bracts ovate to broadly ovate; leaves broadly ovate to broadly elliptic or circular, mostly 20-30 mm long, flat, soft, sparsely to moderately densely pubescent above
- 18 Leaves elliptic, with sessile stellate hairs above; outer bracts ovate, acute to acuminate, grey-pubescent (Mt Peron to Dandaragan) ..... **D. cinerea**
- 18: Leaves broadly ovate to circular, with stipitate stellate hairs above; outer bracts broadly ovate, obtuse, fawn-pubescent (Greenough to Jurien Bay)..... **D. lemaniana**

***Diplolaena angustifolia*** Hook., Bot. Mag. 70: sub tab. 4059 (1843). *Type*: Swan River Colony, Western Australia, *J. Drummond* 1st coll. no. 14 (*holo*: K).

*Diplolaena salicifolia* Bartl. in Endl., Pl. Preiss. 1: 173 (1844). *Type citation*: In calcareo-arenosis ad fluvium Cygnorum prope Freemantle, Woodman's point et in insula Rotenest 15. Aug. 1839. Herb. Preiss. No. 2020. *Type*: Western Australia, 15 August 1839, *L. Preiss* 2020 (*lecto*: LD; *isolecto*: GOET, MEL 232709, 232706, 232708 *p.p.*, 232707 *p.p.*, TCD [*L. Preiss* 528]), lectotype here chosen.

*Diplolaena salicifolia* var. *revoluta* Bartl., *loc. cit.* *Type*: *L. Preiss* 2020 (*lecto*: LD, *isolecto*: GOET, MEL 232709, 232706, 232708 *p.p.*, 232707 *p.p.*, TCD [*L. Preiss* 528], see note below), lectotype here chosen.

*Typification*. As indicated above, *Preiss* 2020 consists of specimens from three localities. The material was evidently mixed when Bartling studied it for he was not able to indicate from which of the localities the two varieties that he recognized came. Seven sheets of no. 2020 have been examined, four in MEL, one in GOET, one in LD, and one in TCD (as no. 528). The specimens consist of two taxa, one of which corresponds to the description of var. *revoluta* and is close to typical *D. angustifolia*, the other corresponds to the description of var. *cuneata* and is close to typical *D. dampieri*, *q. v.* However, material representing each of the varietal names appears to show some introgression between *D. angustifolia* and *D. dampieri*.

The name *D. salicifolia* var. *revoluta* is not illegitimate, even though it is lectotypified on the specimen that is also the lectotype of *D. salicifolia*, since at the time of publication no holotype of either name was indicated (see article 52.1 of the "International Code of Botanical Nomenclature", Greuter *et al.* 1994).

*Diplolaena dampieri* is recorded by recent collections from Rottnest Island, and from Woodman Point (10 km south of Fremantle) southwards to Cape Leeuwin whereas *Diplolaena angustifolia* is now known from about 20 km north of Fremantle north to Eneabba. It would appear probable that both species once grew near Fremantle (see note below) and that they there introgressed; it is also likely that the specimens represented in *Preiss* 2020 were collected from this variable population. However, recent collections from Woodman Point and Rottnest Island show no suggestion of such introgression.

It is interesting to note that James Drummond, in a letter to W.J. Hooker dated 14 October 1839, records that he and Preiss visited Rottnest Island shortly after the 3 August 1839. Here they observed what appears from his description to have been a species of *Diplolaena*, and which, according to Drummond, they also found "on the coast of the mainland". No Drummond collection that corresponds to any of the *Preiss* 2020 specimens has been found.

The specimen cited above from Trinity College, Dublin (TCD) has what is presumably an original *Preiss* label with a *Preiss* "field" collecting number 528 (see Lander 1988); it bears the following information:

Frutex 5-pedalis superbus floribus nutantibus. In calcareis umbrosis ad colliculum secundum fluvium Cygnorum haud longe ab oppido "Freemantle", prope "Woodman's point" nec non in Insula "Rottnest". Floret Aug. 15.39.

This information is different to the version cited by Bartling and explains the apparent intermediate nature of the type material, since the Swan River locality ("secundum fluvium Cygnorum") is intermediate between the present distributions of the two species, *D. dampieri* and *D. angustifolia*.

*Diplolaena salicifolia* is lectotypified so that it corresponds to *D. angustifolia* in the broad sense, for this is the manner in which the name was synonymized by both Benth (1863) and Ostenfeld (1921); *Diplolaena salicifolia* var. *revoluta* is lectotypified so that it becomes a nomenclatural synonym of var. *salicifolia* while *Diplolaena salicifolia* var. *cuneata* is lectotypified so that it becomes a synonym of *D. dampieri*, q.v., in the broad sense.

***Diplolaena cinerea*** Paul G. Wilson, *sp. nov.*

Frutex ad 1.2 m altus. Folia elliptica, applanata, 2 - 3 cm longa, molliuscula, apice rotundato, basi late cuneata, supra sparse vel modice pubescentia, infra modice pubescentia vel velutina. Involucrum 2 cm diam.; bractae exteriores ovatae acutae c. 10 mm longae griseo velutinae; bractae interiores anguste ovatae bracteis exterioribus aequantes vel paulo superantes. Stamina c. 15 mm longa, pallide aurantia.

*Typus*: Lesueur National Park, Western Australia, 12 September 1993, *W. Evans* 711 (*holo*: PERTH 04085981; *iso*: CANB, K, NSW).

*Shrub* to 1.2 m high. *Leaves* elliptic, flat, mostly 20-30 mm long, rounded at apex, broadly cuneate at base, soft, sparsely to moderately densely pubescent above with small sessile stellate hairs, moderately densely soft-pubescent to velvety below. *Flower heads* c. 2 cm diam.; outer bracts ovate, acute, c. 10 mm long, with a yellowish grey-velvety indumentum; inner bracts narrowly ovate, equal to or shortly exceeding outer bracts, pale grey-tomentose. *Petals* linear, membranous, woolly-ciliate, otherwise almost glabrous. *Stamens* c. 15 mm long, pale orange; anthers c. 1.5 mm long, pink.

*Specimens examined*. WESTERN AUSTRALIA: 40 km SSW of Eneabba, *R. Coveny* 3085 (NSW, PERTH); E from Mt Peron, *C.A. Gardner* 9437 (PERTH); 8 km N of Mt Lesueur, *E.A. Griffin* 2221 (PERTH); Cataby Road, W of Dandaragan, Western Australia, 12 Sept. 1988, *E.A. Griffin* 5069A (PERTH).

*Distribution*. Found near the west coast of Western Australia between Mt Peron and Dandaragan.

*Habitat*. On lateritic breakaways, in loamy soils, or in sand over sandstone.

*Etymology*. The epithet *cinerea* refers to the grey colour of the involucral bracts.

*Notes*. This species typically has a yellowish grey velutinous indumentum on the involucral bracts. The indumentum, and the softly puberulous leaves, help to distinguish it from *D. ferruginea* which grows in the same general area, but normally in different habitats.

***Diplolaena dampieri*** Desf., Mem. Mus. Hist. Nat. 3: 452 t. 20 (1817). *Type*: "La terre d'Endracht" [i.e. Shark Bay area but probably actually Geographe Bay], Western Australia, 1801, *J. Leschenault* (*iso*: BM).

*Diplolaena salicifolia* var. *cuneata* Bartl. in Endl., Pl. Preiss. 1: 173 (1844). *Type*: (*lecto*: MEL 232707 right-hand specimen; *isolecto*: MEL 232708 *p.p.*), lectotype here chosen, see comment under *D. angustifolia*.

*Notes*. Leschenault, who was a naturalist on Baudin's expedition, collected in 1801 at Geographe Bay and Shark Bay. The type specimen of *D. dampieri* matches material collected in recent years from Geographe Bay but does not match any material of *Diplolaena* from Shark Bay. It is therefore evident that the locality data were incorrectly recorded.

***Diplolaena drummondii*** (Benth.) Ostenf., Biol. Meddel. Kongel. Danske Vidensk. Selsk. 3/2: 80 (1921). - *D. microcephala* var. *drummondii* Benth., Fl. Austral. 1: 358 (1863). *Type citation*: Swan River, Drummond, 1843, n. 91; Phillips river, Maxwell. *Type*: J. Drummond 91 (*lecto*: K; *isolecto*: MEL 709185), lectotype here chosen.

*Typification*. The Drummond collection cited above corresponds to the plant that is found in the Darling Range in the Mundaring area and also near Collie. It grows in association with laterite.

*Note*. The excluded syntype, Maxwell s.n. from Phillips River (MEL 709140) is *D. microcephala*, q.v.

***Diplolaena eneabbensis*** Paul G. Wilson, *sp. nov.*

Frutex ad 0.5 m altus. Folia elliptica, applanata, plerumque 20-25 mm longa, molliuscula, apice rotundato, basi cuneata, supra sparse pubescentia pilis parvis sessilibus, infra modice molliter pubescentia vel velutinoso. Involucrum c. 2 cm diam.; bractae exteriores ovatae acutae, c. 13 mm longae, indumento molli-rubiginoso; bractae interiores anguste ovatae exteriores paulo superantes.

*Typus*: 1.8 km north of Beekeepers Road, Eneabba, Western Australia, 22 September 1988, J.J. Alford 1208 (*holo*: PERTH 1678892; *iso*: CANB).

*Shrub* to 0.5 m high. *Leaves* elliptic, flat, mostly 20-25 mm long, rounded at apex, broadly cuneate at base, soft, very sparsely pubescent above with small weak sessile stellate hairs, moderately densely soft-pubescent to velvety below. *Flower heads* c. 2 cm diam.; outer bracts ovate, acute, c. 13 mm long, 5-6 mm wide in middle, with a soft reddish brown indumentum; inner bracts narrowly ovate, shortly exceeding outer bracts, reddish brown-tomentose. *Petals* linear, membranous, stellate-pubescent, c. 6 mm long. *Staminal filaments* c. 20 mm long, pink; anther c. 1.3 mm long, pink.

*Specimens examined*. WESTERN AUSTRALIA: First North Rd E of Eneabba, B. & B. Backhouse NS63 (PERTH); 2.5 km S of Greenhead turnoff on Brand Highway, B. & B. Backhouse NS74 (PERTH); 7 km ESE of Eneabba, R.J. Cranfield 8928 (PERTH).

*Distribution*. Only known from near Eneabba, south-west Western Australia.

*Habitat*. Shrubland on sand and gravel over laterite.

*Etymology*. The epithet is derived from the name of the town near where the species is found.

*Notes*. This species is intermediate in morphology between *D. ferruginea* and *D. cinerea*, both of which occur in the Eneabba area. It differs from *D. cinerea* most noticeably in having rusty red (not grey) involucral bracts, and from *D. ferruginea* in having broadly ovate (not narrowly triangular) outer bracts.

***Diplolaena geraldtonensis*** Paul G. Wilson, *sp. nov.*

Frutex ad 1.5 m altus. Folia leviter coriacea, oblonga, 2.5-4 cm longa, apice rotundato, basi cuneata, supra laevis, sparse vel modice pubescentia, subtus laxe velutina. Involucrum c. 1.5 cm diam.; bractae exteriores trullatae vel anguste triangulares, 10-15 mm longae, cervicolores vel rubiginiae; bractae

interiores ovatae vel anguste oblongae, bracteas exteriores paulo superantes. Stamina c. 20 mm longa, pallido rubra.

*Typus*: 1.5 km north along Buller River Road, West Moresby Range, Western Australia, 22 August 1983, R.J. Cranfield 2766 (*holo*: PERTH 00914185).

*Shrub* to 1.5 m high. *Leaves* somewhat leathery; petiole 3-7 mm long; lamina oblong, mostly 2.5-4 cm long, apex rounded, base cuneate; upper surface smooth, sparsely to moderately densely pubescent with weak stellate hairs; lower surface loosely velvety, the outer hairs larger. *Flower heads* c. 15 mm diam.; outer bracts trullate to narrowly triangular, acute, 10-15 mm long, densely tomentose with fawn-coloured (to rusty) unthickened stellate hairs; inner bracts ovate to narrowly oblong, acute to long acuminate, slightly exceeding outer bracts, stellate-pubescent. *Petals* membranous, linear, c. 10 mm long, moderately densely stellate-pubescent. *Staminal filaments* c. 20 mm long, pale red, pilose in lower half; anther red, c. 1.3 mm long.

*Specimens examined*. WESTERN AUSTRALIA: 1 km S of Geraldton, J.A. Armstrong 7013 (PERTH); Burma Rd, A.M. Ashby 1511 (PERTH); Yandanooka, 1932, A.M. Baird (PERTH); Isscka, J.V. Blockley 686 (PERTH); Hutt River, W.H. Butler 17 (PERTH); 28 km S of Northampton, R.J. Cranfield 4068 (PERTH); Howatharra Hill Reserve, Moresby Range, D. & N. McFarland 1060 (PERTH).

*Distribution*. Occurs in south-western Western Australia near the west coast from Hutt River south to Dongara.

*Habitat*. In low shrubland in sand on gravel or laterite.

*Etymology*. This species is named after the town of Geraldton near where the plant is found.

*Notes*. A specimen collected c. 3 km south-east of Geraldton (J.A. Armstrong 7013) is intermediate between *D. geraldtonensis* and *D. grandiflora*; only the latter of these species was growing in the same vicinity.

***Diplolaena graniticola*** Paul G. Wilson, *sp. nov.*

[*D. microcephala* auct. non Bartl. sensu lectotypico: Bartl., Pl. Preiss. 1: 173 (1844) *p.p.* as to syntype L. Preiss 2018].

Frutex ad 1.5 m altus. Folia chartacea; petiolus c. 5 mm longus; lamina applanata, elliptica vel late elliptica, plerumque 15-25 mm longa, apice rotundato, basi cuneata, pagina superiora pilis parvulis sparse pubescentia; pagina inferiora pilis parvulis modice pubescentia. Involucrum c. 15 mm diam.; bracteae exteriores anguste triangulares, 10-14 mm longae, virido-vel rubiginoso-pubescentiae. Stamina 20 mm longa, flava vel rubra.

*Typus*: Boyagin, Western Australia, 8 August 1979, H. Demarz 7396 (*holo*: PERTH 00919470).

*Shrub* to 1.5 m high. *Leaves* papery; petiole c. 5 mm long; lamina flat, elliptic to broadly elliptic, mostly 15-25 mm long, apex rounded, base cuneate; upper surface with sparse stellate indumentum of very small unthickened hairs; lower surface with a moderately dense stellate indumentum of small unthickened



hairs. *Flower heads* c. 15 mm diam.; outer bracts narrowly triangular, 10-14 mm long, pubescent with very small green or rusty stellate hairs; inner bracts narrowly triangular, slightly exceeding outer bracts, tomentose. *Petals* membranous, linear, c. 6 mm long, sparsely stellate-pubescent. *Stamininal filaments* 20 mm long, yellow to red, pilose in lower half; anther red, 1-1.3 mm long.

*Selection of specimens examined.* WESTERN AUSTRALIA: 15 km SE of Dale, *D.E. Albrecht* 4156 (MEL, PERTH); 2 miles [3.2 km] W of Wagin, *K. Newbey* 1281 (PERTH); Tutanning, 9 Aug. 1966, *S. James* (PERTH).

*Distribution.* Western Australia, east of Perth in the Darling Range from Mt Observation south to Wagin and Collicie.

*Habitat.* Recorded as predominantly growing on or around granite outcrops.

*Etymology.* The specific epithet refers to the preferred habitat of this species.

*Notes.* *Diplolaena graniticola* grades to the east into *D. velutina* and to the west into *D. drummondii*, while to the south it appears to merge into *D. microcephala*. These four species could be regarded as infraspecific taxa of *D. microcephala*.

***Diplolaena leemaniana*** Paul G. Wilson, *sp. nov.*

Frutex effusus ad 0.7 m altus. Folia late ovata vel late elliptica vel circularis, 20 x 16 mm - 35 x 25 mm, ad apicem et basim rotundata, mollia, supra sparse vel modice pubescentia trichomis stipitatis instructa, subtus molliter pubescentia vel velutina. Involucrum c. 2 cm diam.; bracteae exteriores late ovatae, obtusae, c. 10 mm longae, indumento cervicolore; bracteae interiores ovatae vel late ovatae, bracteae exteriores aequantes vel paulo superantes. Stamina 15-20 mm longa, pallido rubra.

*Typus:* South Arrowsmith River, Cliff Head turnoff, Western Australia, 7 September 1969, *A.C. Burns* 117 (*holo:* PERTH 00920002).

Spreading *shrub* to 0.7 m high. *Leaves* somewhat flaccid, broadly ovate or broadly elliptic to circular, flat, mostly 20-35 mm x 16-25 mm, rounded at apex and base, soft, sparsely to moderately densely pubescent above when mature with stipitate stellate hairs, moderately densely soft-pubescent to velvety below. *Flower heads* c. 2 cm diam.; outer bracts broadly ovate, obtuse, c. 10 mm long, with a fawn indumentum and a few large rusty brown stellate hairs; inner bracts ovate to broadly ovate, equal to or shortly exceeding outer bracts, grey- to rusty-stellate-tomentose; innermost bracts red, sparsely pubescent. *Petals* linear, membranous, woolly-ciliate, otherwise almost glabrous. *Staminal filaments* 15-20 mm long, pale red; anther c. 1.5 mm long, pink.

*Selected specimens examined.* WESTERN AUSTRALIA: 5 km S along road to Cliff Head from Brand Highway, *D.E. Albrecht* 4187 (PERTH); South Dongara, *N.H. Specks* s.n. (PERTH); 8 km SW of Greenough, *G.J. Keighery* 5172 (PERTH); Jurien Bay to Green Head, *M.E. Phillips* 021820 (PERTH).

*Distribution.* South-western Western Australia near the west coast between Greenough and Jurien Bay.

*Habitat.* Coastal, in sand over limestone.

*Etymology.* The specific epithet is derived from the township of Leeman which is near the centre of the distribution of the species.

*Notes.* This species may be recognized by the broadly elliptic to circular leaves, their somewhat flaccid texture, and their soft indumentum. It may also be distinguished by the stipitate stellate hairs that form the covering to the leaves' upper surface, for the leaves of most species of *Diplolaena* have an indumentum with an inner layer of sessile stellate hairs and an outer layer of larger stipitate hairs, whereas in *D. leemaniana* only stipitate hairs are present.

***Diplolaena microcephala*** Bartl. in Lehmann, Pl. Preiss. 1: 173 (1844). *Type citation:* In littore rupestri arenoso inter frutices densos promontorii Cape Riche 20. Nov. 1840. Herb. Preiss. No. 2019, nec non in montosis glareosis sterilibus districtus Grantham m. Mart. 1841. No. 2018. *Type:* Cape Riche, Western Australia, 20 November 1840, L. Preiss 2019 (*lecto:* MEL 709201), lectotype here designated.

[*D. microcephala* var. *drummondii* auct. non Benth. *sensu lectotypico:* Benth., Fl. Austral. 1: 358 (1963) p.p., as to "Phillips river, Maxwell" (MEL 709140)].

*Distribution.* Found from near Walpole east to Esperance near the south coast of Western Australia.

*Habitat.* This species occurs principally along streams.

*Notes.* The excluded syntype of *Diplolaena microcephala*, L. Preiss 2018, is here referred to *D. graniticola*.

***Diplolaena mollis*** Paul G. Wilson, *sp. nov.*

Frutex ad 2 m altus. Folia late elliptica vel late obovata, 1-2 cm longa, apice rotundato, basi late cuneata, utrinque velutina. Involucrum 15-20 mm diam.; bracteae exteriores ovatae vel anguste ovatae, 6-10 mm longae, dense rubiginoso-velutinae; interiores late ovatae vel anguste oblongae, acutae, longitudine bracteas exteriores aequantes vel paulo superantes. Stamina 15-20 mm longa, rubra.

*Typus:* 1 km south of Kalbarri, Western Australia, 6 May 1968, Paul G. Wilson 6559 (*holo:* PERTH 00922161; *iso:* CANB, K).

*Shrub* to 2 m high. *Leaves* leathery; petiole 3-6 mm long; lamina flat, broadly elliptic to broadly obovate, mostly 1-2 cm long, apex rounded, base cuneate, both sides with a close but very dense fawn velvety indumentum of small weak stellate hairs. *Flower heads* 15-20 mm diam.; outer bracts ovate, 6-10 mm long, densely velvety with small stellate hairs; inner bracts broadly ovate to narrowly oblong, acute, shortly exceeding outer bracts, densely stellate-hairy; innermost bracts narrowly oblong, thin, almost glabrous. *Petals* linear, c. 7 mm long, woolly-stellate to glabrous. *Staminal filaments* 15-20 mm long, pilose towards base, deep red; anther 1-1.4 mm long, red.

*Selected specimens examined.* WESTERN AUSTRALIA: Eagle Gorge, 6 km S of Red Bluff, J.A. Armstrong 7011 (PERTH); 40 km NE of Kalbarri, 20 May 1968, J. Bannister (PERTH); Cooloomia Nature Reserve, S.D. Hopper 1364 (PERTH); Murchison River, 20 Sep. 1948, C. Morrison & D.C. Serventy (PERTH); South Hamelin, Sep. 1953, N.H. Speck (PERTH); Dirk Hartog Island, A.S. George 11526 (PERTH); 20 miles [32 km] SSE of Tamala Homestead, A.S. George 9593 (PERTH).

*Distribution.* Western Australia, on or near the west coast from Shark Bay south to Kalbarri.

*Habitat.* Growing in sand over limestone in low shrubland.

*Etymology.* The specific epithet refers to the soft texture of the leaves.

*Notes.* *Diplolaena mollis* may be distinguished from other members of the genus by the shape of the leaves and by the close velvety indumentum which covers both surfaces. It is found in the same area as *D. grandiflora* and the two occasionally hybridize.

***Diplolaena obovata*** Paul G. Wilson, *sp. nov.*

Frutex erectus ad 80 cm altus. Folia chartacea, late ovata, praecipue 6-12 mm longa, apice rotundato, basi cuneata, utrinque sparse stellata. Involucrum c. 10 mm diam.; bracteae exteriores late ovatae, c. 6 mm longae, rubiginosae; bracteae interiores rubiginosae late ovatae bracteis exterioribus paulo superantes. Stamina c. 15 mm longa, viridia vel flava.

*Typus:* Ocean Farm, Lancelin, Western Australia, 10 June 1981, *R.J. Cranfield* 1688 (*holo:* PERTH 922676).

Small erect shrub 20-80 cm high. Leaves papery; petiole 3-5 mm long; lamina broadly obovate, mostly 6-12 mm long, apex rounded, base cuneate; upper and lower surfaces with a sparsely stellate indumentum of even-sized hairs. Flower heads c. 10 mm diam.; outer bracts broadly ovate, c. 6 mm long, rusty-pubescent with unthickened stellate hairs; inner bracts broadly ovate, slightly exceeding outer bracts, rusty-stellate-pubescent. Petals membranous, linear, c. 9 mm long, moderately densely stellate-pubescent. Staminal filaments c. 15 mm long, green to yellow, pilose in lower half; anther red, c. 0.9 mm long.

*Specimens examined.* WESTERN AUSTRALIA: 11 km NE of Cervantes, *A.H. Burbidge* 3905 (PERTH); 5 km along Jurien Bay road to Jurien Bay, *H. Demarz* 108 (PERTH); 4 km from Seabird, *E.A. Griffin* 5697 (PERTH); Lancelin, 24 May 1966, *M. Barrow* (PERTH); 4 miles [6.4 km] from Jurien Bay, *J.S. Beard* 7812 (PERTH); Mt Lesueur Reserve, *E.A. Griffin* 4175 (PERTH); Cockleshell Gully flats, *C.A. Gardner* 8417 (PERTH).

*Distribution.* Occurs in south-west Western Australia from Green Head south to Lancelin about 5 km inland of the west coast.

*Habitat.* Grows in shallow sand over limestone.

*Etymology.* The specific epithet refers to the shape of the leaves.

*Notes.* *Diplolaena obovata* closely resembles *D. microcephala* (a south coastal species), particularly in the sizes of the leaves and involucres. It differs most markedly in its leaf shape (broadly obovate rather than elliptic) and in its sparse indumentum.

***Diplolaena velutina* (Paul G. Wilson) Paul G. Wilson, *stat. nov.***

*D. microcephala* var. *velutina* Paul G. Wilson, Nuytsia 1:198(1971). *Type*: 2 miles [3.2 km] north of Wyalkatchem, Western Australia, 30 June 1959, *T.E.H. Aplin* 509 (*holo*: PERTH01636146)

*Notes*. This species occurs in inland south-western Western Australia from near Coorow south-east to near Kondinin. It has generally been recorded as growing on or around granite hills. As is noted above, in the Darling Range area it grades to the west into *D. graniticola*, while towards its northern limit, near Watheroo, it grades into *D. ferruginea* and into *D. cinerea*.

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Laurie Jessup, while the Australian Botanical Liaison Officer, provided photographs of the *Diplolaena* material at the BM that was studied by Robert Brown. David Mabberley (herb. OXF) provided photographs of the specimens collected by William Dampier in Western Australia. The herbaria GOET, LD, MEL, and TCD generously arranged for the loan of type material. This work was partly funded by a grant from the Australian Biological Resources Study.

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## New names and new taxa in the genus *Boronia* (Rutaceae) from Western Australia, with notes on seed characters

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### Abstract

Wilson, Paul G. New names and new taxa in the genus *Boronia* (Rutaceae) from Western Australia, with notes on seed characters. Nuytsia 12 (1): 119-154 (1998). As a precursor to the treatment for the "Flora of Australia" of Western Australian species of *Boronia* (Rutaceae), the following seven species and eight varieties or subspecies are described as new: *B. acanthoclada*, *B. anceps*, *B. baeckeacea* subsp. *patula*, *B. baeckeacea* subsp. *rosea*, *B. corynophylla*, *B. crenulata* var. *angustifolia*, *B. crenulata* subsp. *obtusa*, *B. exilis*, *B. humifusa*, *B. juncea* subsp. *minima*, *B. purdieana* subsp. *calicicola*, *B. ramosa* subsp. *lesueurana*, *B. scabra* subsp. *attenuata*, *B. scabra* subsp. *condensata*, *B. tetragona*, and *B. westringioides*. The following new subspecific combinations are made: *B. crenulata* subsp. *pubescens* (Benth.) Paul G. Wilson, *B. crenulata* subsp. *vininea* (Lindl.) Paul G. Wilson, *B. fastigiata* subsp. *tenuior* (Benth.) Paul G. Wilson, *B. juncea* subsp. *laniflora* (Bartl.) Paul G. Wilson, *B. juncea* subsp. *micrantha* (Bartl.) Paul G. Wilson. Lectotypes have been designated for a number of species. The seeds typical of each of the sections or series in *Boronia* are described.

### Introduction

This paper is a precursor to the treatment of the Western Australian taxa in the genus *Boronia* Sm. (Rutaceae) for the "Flora of Australia". New taxa are described and new lectotypifications are made. Apart from the description of *B. corynophylla*, this paper, and its accompanying flora treatment, exclude those species that are currently placed in sect. *Valvatae* which comprises all tropical members of the genus as well as several temperate species.

The genus *Boronia* was divided by Bentham (1863) into seven series and by Engler (1896) into three sections, one of which was divided into five series. It is here proposed to divide the genus into four sections, none of which corresponds precisely to Bentham's or Engler's groups, and to treat sect. *Valvatae* in the broad sense. This last section is under investigation by Duretto (1997). Marco Duretto is also revising the eastern states' species of the other sections.

Weston *et al.* (1984) prepared a cladistic treatment of the genus to which the taxonomy accepted here largely corresponds, however, their analysis did not include *Boronia cymosa*, which I consider to be the sole representative of the section *Imbricatae* as lectotypified.

The probability of the genus being polyphyletic without the inclusion of *Boronella* from New Caledonia was indicated by Weston *et al.* (1984), and an investigation by me of petal venation and seed morphology, characters which were not included in that study, could strengthen the proposal. However, Hartley (1995) doubts this close relationship and supports the argument for retaining *Boronella* as a distinct genus with details from a study of the articulation in the branchlets and of the shape of the embryonic cotyledons. If the close relationship of *Boronia* to *Boronella* were to be accepted then floral and seed characters suggest that the latter is more closely related to sect. *Boronia* than that section is to any of the other sections in the genus. Logically therefore *Boronella* should either be made a section of *Boronia* or the sections of *Boronia* should be raised to generic level. In spite of these reservations Duretto and I have decided for the "Flora of Australia" to retain the genus with its traditional circumscription, while *Boronella* is assumed to be generically distinct.

As is noted above, the recognition of the infrageneric taxa within *Boronia*, while based largely on floral morphology, is strongly supported by seed morphology. The opportunity is therefore taken to describe the seed types that have been observed in representative taxa of Western Australian species of *Boronia*.

### Seed terminology in the Boronieae

*Sclerotesta*. The hard, thick, and brittle portion of the testa. It is always black in colour and is either smooth or variably corrugate.

*Outer testa*. That portion of the testa outside the sclerotesta. It is membranous, papery, coriaceous, or brittle. It may be smooth, or it may follow corrugations present on the sclerotesta, or it may have corrugations that are independent of the sclerotesta.

*Micropyle*. This is minute and circular or rarely narrowly elliptic. It is always positioned on the upper adaxial margin of the seed.

*Hilum*. The scar formed by the dehiscence of the funicle or aril'. It is always in the central adaxial area of the seed and it varies in shape from linear to circular. In *Boronia* sect. *Boronia* it is sunken between lateral lip-like raised portions of the outer integument and is here referred to as labiose.

*Raphe*. The vascular strand and associated tissue that pass from the base of the hilum to the chalaza. It varies from being shrivelled and insignificant to large and fleshy.

*Raphe cover*. The tissue that forms a cover to the raphe. It is continuous with and usually has the same texture as the outer testa and therefore varies from being membranous to brittle.

*Chalazal aperture*. The circular hole in the sclerotesta through which the raphe passes into the chalaza. It is positioned beneath the raphe, either at the base of the seed or at its lower adaxial margin.

*Hilar strands*. In some genera the seed possesses a cream- coloured ligament-like tissue on its adaxial surface. This tissue has the appearance of a strand; it surrounds the hilum and extends, as a single thread, to the raphe. The strand is here called the hilar strand. It is shed on or shortly after the discharge of the seed. Hilar strands are found in the seeds of *Chorilaena*, *Phebalium* sect. *Goniocladus*, *Rhadinothamnus*,

and *Asterolasia pro parte*. From a study of stages in the development of ovules in these taxa and by comparing them with seeds at various stages of development in other members of the Boronieae, it appears that the hilar strand arises from a narrow portion of the outer testa (formed from the outer integument) that surrounds the hilum. In the early stages of seed development the future strand is intimately fused to the rest of the outer testa. When nearly mature it becomes separated from the testa and eventually falls away from the seed.

In most genera of the Boronieae a pale line around the hilum can be observed in the developing ovule. In *Correa* this area remains pale in the mature seed. In *Boronia* sect. *Boronia* and in *Eriostemon* sect. *Erionema* this area becomes brittle and usually glossy; it eventually becomes raised around an apparently sunken hilum.

In *Philotheca*, in *Eriostemon* sect. *Nigrostipulae*, and in *Geleznovia* the developing ovule has a brown ring around the hilum and raphe that appears to develop into the hard cover to the raphe.

The hilar strand is therefore homologous with the lips that surround the hilum and raphe in *Boronia* sect. *Boronia* and in *Eriostemon* sect. *Erionema*, and it is also homologous with the hard cover to the raphe that is found in seeds of *Drummondita*, *Geleznovia*, and *Eriostemon* sect. *Nigrostipulae*.

*Placental endocarp*. The endocarp in the mature fruits of the Boronieae consists of two parts: an elastic cartilaginous portion that ultimately ejects the seeds from the fruit, and a membranous or thick and fleshy portion that separates from the elastic endocarp. The placental area of the ovary forms part of this membranous to fleshy portion and for this reason the name "placental endocarp" was used by Wilson (1970) while Kaastra (1982) has preferred the phrase "axial part of the endocarp", Kallunki (1992) the "ventral portion of the endocarp", Corner (1976) the aril, and Gereau (1990) the "arillodio-membranaceo". The last two terms are possibly inappropriate since it appears to be true endocarp, and is not formed from the funicle. In some species of the Boronieae (e.g. *Boronia juncea*) a true aril is present that is formed as an extension of the funicle.

## New taxa and lectotypifications

***Boronia* Sm., Tracts Nat. Hist. 288 (1798).**

*Type: Boronia pinnata* Sm., lectotype here chosen.

*Notes.* *Boronia pinnata* was one of four *Boronia* species described by J.E. Smith and since it was the only one that had been introduced into cultivation he gave it most prominence.

### 1. *Boronia* Sm. sect. *Boronia*

#### 1a. *Boronia* Sm. sect. *Boronia* ser. *Boronia*

*Boronia* ser. *Heterandrae* Benth., Fl. Austral. 1: 315 (1863). - *Boronia* sect. *Heterandrae* (Benth.) Engler, Nat. Pflanzenfam. 3/4: 136 (1896). *Type: Boronia megastigma* Nees, lectotype here chosen.

*Boronia* sect. *Octarrhena* F. Muell., Pl. Indig. Col. Victoria 1: 113 (1862). Type: *Boronia pinnata* Sm., lectotype here chosen.

*Boronia* ser. *Pinnatae* Benth., Fl. Austral. 1: 309, 307 (1863). - *Boronia* sect. *Pinnatae* (Benth.) De Wild., Icon. Select. 2: 67 (1901). Type: *Boronia pinnata* Sm.

*Boronia* ser. *Terminales* Benth., Fl. Austral. 1: 310, 323 (1863). Type: *B. capitata* Benth., lectotype here chosen.

*Boronia* ser. *Variabiles* Benth., F. Austral. 1: 309, 320 (1863). Type: *B. crenulata* Sm., lectotype here chosen.

*Boronia* ser. *Ovatae* Paul G. Wilson, Nuytsia 1: 204 (1971). Type: *B. ovata* Lindl.

*Seed morphology.* Seed kidney-shaped, adaxial margin flat or convex. Testa smooth; outer testa coriaceous, matt, black. Hilum sunken, linear to elliptic in centre of adaxial margin, surrounded by glossy labiose (lip-like) raised margin which surrounds raphe. Raphe fleshy. Chalazal opening basal. Placental endocarp membranous, caducous. (Figure 1)

*Species examined.* Of the 23 Western Australian species recognized in this series the following nine were examined for seed characters: *Boronia clavata*, *B. crenulata*, *B. humifusa*, *B. inornata*, *B. ovata*, *B. purdieana*, *B. scabra*, *B. spathulata*, and *B. tetrandra*.

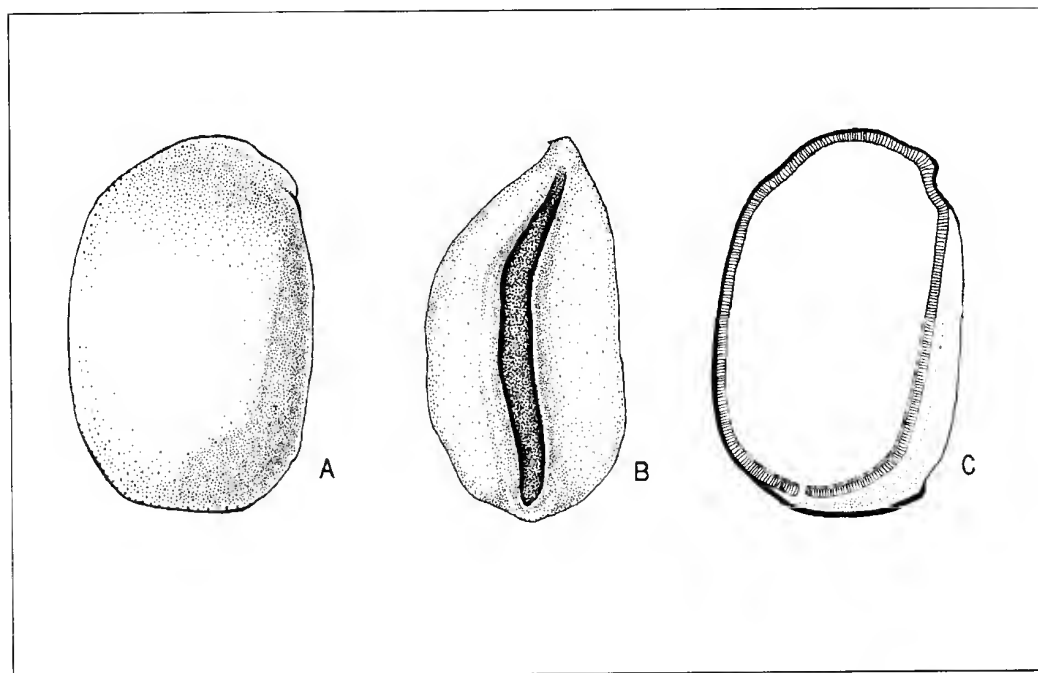


Figure 1. *Boronia crenulata* subsp. *viminea* seed. A - lateral view, B - adaxial surface, C - longitudinal radial section, all x20. Drawn from P. Luff, 3 Oct. 1963.



*Notes.* The most obvious character that distinguishes the seed of this section from seeds of other taxa in the Boronieae is the presence of the labiose margin to the hilum and its glossy surround. There is some variation to the usual situation. In *B. scabra* the hilum is short, elliptic and not sunken; the raphe passes as a ligament to the glossy chalazal area on the adaxial face. In *B. humifusa* the hilum is again short while the raphe is a broad tissue covered by a glossy cover on the adaxial face. (Figure 2F,G)

***Boronia albiflora*** R. Br. ex Benth., Fl. Austral. 1: 317 (1863). *Type citation:* South coast, R. Brown; King George's Sound, Baxter; Garden Range, hills N of Stirling range, and Cheyne Beach, Maxwell. *Type:* Bay 1 [Lucky Bay], Western Australia, [January 1802], R. Brown (lecto: K; isolecto: MEL 1058486), lectotype here chosen.

***Boronia crassifolia*** Bartl. in Lehm., Pl. Preiss. 1: 169 (1844). *Type:* Interior of south-west Western Australia, October 1840, L. Preiss 2033 (lecto: LD; isolecto: MEL 1058498), lectotype here chosen.

*Boronia humilis* Turcz., Bull. Soc. Imp. Naturalistes Moscou 25/2: 160 (1852). *Type:* Western Australia, J. Drummond 5th coll. no. 199 (iso: TCD).

*B. multicaulis* Turcz., Bull. Soc. Imp. Naturalistes Moscou 25/2: 161 (1852). *Type:* Western Australia, J. Drummond s.n. (holo: KW, photo seen).

***Boronia crassipes*** Bartl. in Lehm., Pl. Preiss. 1: 168 (1844). *Type:* Mt Wuljenup [Willyung Hill], Western Australia, 14 October 1840, L. Preiss 2040 (lecto: LD; isolecto: K photo seen, MEL 1058499, MEL 1058500, MEL 1058501), lectotype here chosen.

***Boronia crenulata*** Sm., Trans. Linn. Soc. London 8: 284 (1807). *Type:* King George Sound, Western Australia, 1803, A. Menzies (holo: LINN).

*Notes.* The sheet with the Menzies collection in herb. LINN bears the date 1803 which is possibly the year in which the material was received by Smith. Menzies visited King George Sound with George Vancouver in 1791.

The leaf shape in each of the different infraspecific taxa is very variable, even on the same plant or in collections from the same area. A further complication is that the subspecies grade into each other, therefore many plants do not fit precisely into the leads provided below.

- 1 Leaves linear to broadly obovate, narrowed at base, eciliate; branchlets glabrous or puberulous
- 2 Petals subapically apiculate, usually prominently so; sepals acuminate or obtuse with apiculum, densely ciliate ..... subsp. **crenulata**
- 2 Petals either not apiculate or minutely so; sepals obtuse or acute, minutely ciliate or eciliate
- 3 Sepals broadly ovate, c. 2 mm long, obtuse or rounded at apex, minutely subapically apiculate, ciliate ..... subsp. **obtus**
- 3: Sepals ovate to triangular, 1.5-2 mm long, obtuse to acute, not subapically apiculate, eciliate or minutely ciliate ..... subsp. **viminea**
- 1: Leaves broadly elliptic to obovate, sometimes cordate at base, sparsely long-ciliate; branchlets pilose ..... subsp. **pubescens**

**Boronia crenulata** Sm. subsp. **crenulata**

*Distribution.* Occurs in the south-west of Western Australia, towards the south coast from Augusta east to Bremer Bay and north to the Stirling Range and from there to the eastern margin of the Darling Range.

*Notes.* Two varieties are recognized.

Leaves narrowly to broadly obovate ..... var. **crenulata**

Leaves linear ..... var. **angustifolia**

**Boronia crenulata** Sm. subsp. **crenulata** var. **crenulata**

*B. viminea* var. *gracilis* Benth., Fl. Austral. 1: 325 (1863). - *B. crenulata* var. *gracilis* (Benth.) Paul G. Wilson, Nuytsia 1: 204 (1971). *Type:* Western Australia, 1848, *J. Drummond* 92 (*holo:* K; *iso:* TCD).

*Leaves* narrowly to broadly obovate, 7-12 mm long, rounded to obtuse. *Flowers* predominantly axillary with 1 or 2 pairs of bracteoles. *Sepals* ovate, acuminate, 2-3 mm long. *Petals* glabrous outside, minutely subapically apiculate.

*Distribution.* Occurs over the entire range of the subspecies.

*Notes.* The variant from near Albany with broadly obovate leaves corresponds to the type of *B. crenulata* while the variant from near Bremer Bay with narrowly obovate leaves corresponds to the type of *B. viminea* var. *gracilis*.

The variant found north-west of the Stirling Range and towards the Darling Range is sometimes puberulous all over; it has narrow leaves and narrowly triangular to triangular sepals. This variant is somewhat intermediate in morphology between subsp. *crenulata* and subsp. *viminea*.

Over most of its distribution the branches of this variety are puberulous but in the Pemberton-Walpole area they are pilose which suggests intergradation with subsp. *pubescens*.

**Boronia crenulata** subsp. **crenulata** var. **angustifolia** Paul G. Wilson, *var. nov.*

Folia linearia, 15-30 mm longa, acuta. Flores plerumque ad ramulis brevibus axillaribus terminati. Sepala anguste triangularia, acuminate, c. 3 mm longa. Petala glabra, manifeste subapicaliter apiculata.

*Typus:* Near junction of Ellen and South Bluff tracks, Stirling Range, Western Australia, 26 September 1975, *R. Voutier* 795 (*holo:* PERTH00962651).

*Leaves* linear, 15-30 mm long, acute. *Flowers* mostly terminal to short axillary shoots. *Sepals* narrow triangular, acuminate, c. 3 mm long. *Petals* glabrous, prominently subapically apiculate.

*Selected specimens examined.* WESTERNAUSTRALIA: Ellen Peak, 21 Oct. 1902, *A. Morrison* (PERTH); Ellen track, Stirling Range, 24 Oct. 1973, *R. Voutier* 795 (PERTH).

*Distribution.* Known only from an area near the type locality in the Stirling Range, south-west Western Australia.

*Conservation status.* This variety, although restricted in its distribution, is located in a national park where it is not at risk. A Priority Four category is therefore appropriate.

*Etymology.* The varietal epithet is derived from the Latin words *angustus*, narrow, and *folium*, leaf, referring to the very narrow leaves of this taxon.

*Notes.* This variety is identical in flower characters to var. *crenulata* which is found elsewhere in the the Stirling Range.

***Boronia crenulata* subsp. *obtusa*** Paul G. Wilson, *subsp. nov.*

Ramuli minute puberuli vel glabri. Folia anguste obovata, 10-15 mm longa,  $\pm$  integra, ad apicem rotundata vel obtusa, ad basim attenuata, glabra, eciliata. Sepala late ovata, 2 mm longa, crassa, eciliata, glabra, ad apicem obtusa vel rotundata, subapicaliter apiculata. Petala glabra, non-apiculata vel minute subapicaliter apiculata.

*Typus:* 3 km south-west of gate in Rabbit Proof Fence, east of Lake King, Western Australia, 7 August 1968, R.A. Saffrey 332 (*holo:* PERTH 00946508; *iso:* K).

*Branchlets* minutely puberulous in strips or glabrous. *Leaves* narrowly obovate, 10-15 mm long, entire or almost so, rounded or obtuse at apex, attenuate at base, glabrous, eciliate. *Pedicels* glabrous or sparsely puberulous, thick; bracteoles sub-basal, c. 1 mm long, obtuse. *Sepals* broadly ovate, c. 2 mm long, thick, ciliolate, glabrous, obtuse or rounded at apex, subapically apiculate. *Petals* glabrous, rounded at apex, either not apiculate or minutely sub-apically apiculate.

*Selected specimens examined.* WESTERN AUSTRALIA: 17 km E of Grass Patch, P. vander Moezel 445 (PERTH); 14 km E of the mouth of the Oldfield River, A.E. Orchard 1487 (PERTH); 73 km E of Jerramungup, G. Perry 131 (PERTH); 40 km ESE of Lake King township, P.G. Wilson 6855 (PERTH).

*Distribution.* Occurs in south-west Western Australia from Nyabing and Ongerup east to Norseman and from Newdegate south to the coast.

***Boronia crenulata* subsp. *pubescens*** (Benth.) Paul G. Wilson, *comb. et subsp. nov.*

*Boronia crenulata* var. *pubescens* Benth., Fl. Austral. 1: 323 (1863). - *B. haloragoides* F. Muell., Fragm. 11: 97 (1880). *Type citation:* W. Australia, Drummond; Vasse river, Oldfield. *Type:* Vasse River, Western Australia, A. Oldfield (*lecto:* MEL 1058502), lectotype here chosen.

*Distribution.* Found in the south-west of Western Australia between Cape Naturaliste and Pemberton.

***Boronia crenulata* subsp. *viminea*** (Lindl.) Paul G. Wilson, *subsp. et comb. nov.*

*B. viminea* Lindl., Sketch Veg Swan R. 17 (1839). *Type:* Swan River Colony, Western Australia, J. Drummond s.n. (*syn:* CGE), J. Mangles (*syn:* CGE).

*B. viminea* var. *latifolia* Benth., Fl. Austral. 1: 325 (1863). *Type*: Canning River, Perth, Western Australia, November 1841, L. Preiss 2022 (*lecto*: LD; *isolecto*: MEL 1058527), lectotype here chosen.

*B. tenuifolia* Bartl. in Lehm., Pl. Preiss. 1: 168 (1844). *Type*: Canning River, Perth, Western Australia, November 1841, L. Preiss 2022 (*lecto*: LD; *isolecto*: MEL 1058527), lectotype here chosen.

*B. machardiana* F. Muell., Fragm. 9: 115 (1875). *Type*: Blackwood River, Western Australia, 1874, M. McHard (*iso*: PERTH 00997528, fragment).

*Typification*. The type of *B. machardiana* is of a variant that is most similar to material found just south of Perth although it is said to have come from the Blackwood River area which is in the far south-west of the State.

***Boronia humifusa*** Paul G. Wilson, *sp. nov.*

Ramuli acute 4-angulati, glabri vel in lineis oppositis scabridi. Folia sessilia, simplicia, oblonga vel oblongo-elliptica, 1-2 cm longa, integra, plana, obtusa, infra glabra, supra scabridula. Flores in cymas apertas; pedunculus gracilis, c. 1 cm longus; pedicellus gracilis, 5-10 mm longus, in medio breviter bibracteolatus. Sepala deltata, c. 1.5 mm longa, glabra. Petala imbricata, elliptica, 6-7 mm longa, extra glabra, intra sparse pilosa, rubra, ad apicem plana, non apiculata; nervatura pinnata, nervo medio unico. Stamina 8, omnino fertilia; filamenta dense ciliata, ad apicem verrucosa. Discus integra, glabra. Ovarium glabrum; stylus stigmaque cylindracea, c. 0.5 mm longa, glabra.

*Typus*: Capel to Donnybrook road, Western Australia, 16 June 1996, B.J. Lepschi & T.R. Lally 2611 (*holo*: PERTH 04334221; *iso*: CANB, K).

Low-growing wiry *perennial*. Stems and branches sharply 4-angled, glabrous or sometimes scabrid in opposite lines. Leaves sessile, simple, oblong to oblong-elliptic, 1-2 cm long, entire, flat (sometimes recurved when dry), obtuse, glabrous below, scabridulous above. Flowers in open cymes terminal to main and lateral branches; peduncle slender, c. 1 cm long; pedicels slender, 5-10 mm long, medially shortly bibracteolate. Sepals deltate, c. 1.5 mm long, glabrous, glandular-punctate. Petals imbricate, elliptic, 6-7 mm long, wrinkled on margin when dry, pilose within towards base with simple hairs, glabrous outside, red, apex neither inflexed nor apiculate; venation pinnate with a single medial vein. Stamens 8, all similar and fertile; filament compressed-terete, s-curved, densely ciliate, apex globular and verrucose; anther affixed subapically to adaxial margin, thecae c. 1 mm long, white apiculum c. 0.5 mm long. Disc cushion-shaped, entire, glabrous. Ovary glabrous; style and stigma together cylindrical, c. 0.5 mm long, glabrous. Seed semicircular, c. 1 mm long; outer testa smooth, black; adaxial margin with glossy cover to raphe, without a groove. (Figure 2)

*Other specimens examined*. WESTERN AUSTRALIA: SSE of Capel on Donnybrook road, R. Davies 125 (PERTH); *ibid.*, B.J. Lepschi & T.R. Lally 3121 (PERTH); *ibid.*, D. Papenfuss 300 (PERTH); 10 km W of Donnybrook, P.A. Jurjevich 1831 (PERTH); Tutunup, Sep. 1945, Forester Weston (PERTH).

*Distribution*. South-west Western Australia, between Capel and Donnybrook.

*Habitat*. Growing in Jarrah - Marri open forest on lateritic soil.

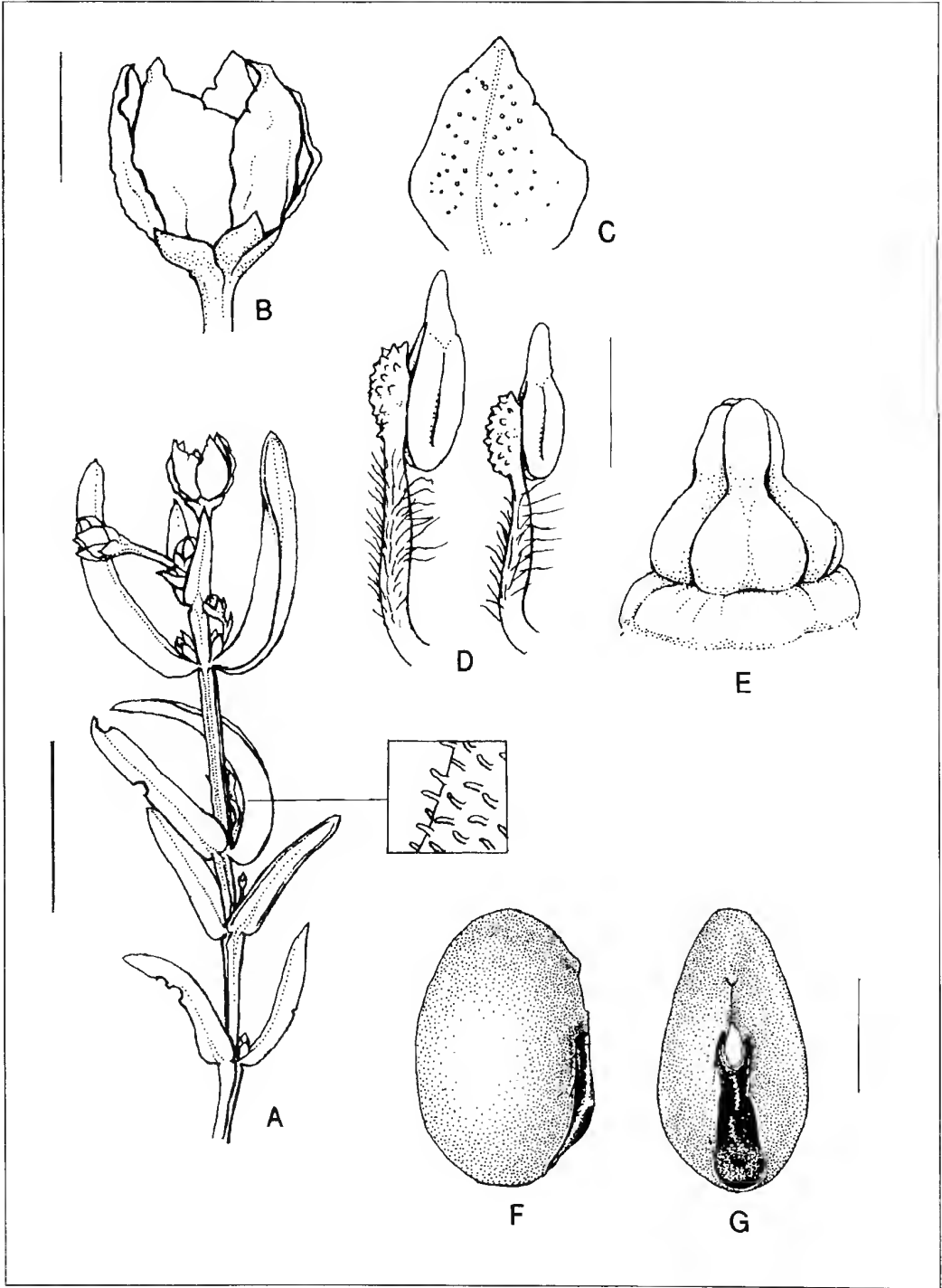


Figure 2. *Boronia humifusa* A - flowering branch, B - flower, C - petal, D - sepaline and petaline stamens, E - disc and pistil, F - lateral view of seed, G - adaxial surface of seed. Scale bars: 2 cm (A), 4 mm (B,C), 1 mm (D,E, F and G). Flowering portions drawn from *B.J. Lepschi & T.R. Lally* 2611; seed drawn from *R.P. Davies* 125.

*Conservation status.* Known from one small area of forest which is subject to mining and therefore probably places the species under threat. A Priority One classification may be appropriate.

*Etymology.* The specific epithet, *humifusa*, is a Latin word meaning spread-out over the ground and refers to the low-growing habit of the plant.

*Notes.* The relationships of this species are uncertain. It does not agree with other members of sect. *Boronia* since the petals lack an apiculum and have only one main vein, while the seed lacks an adaxial groove. In typical members of sect. *Boronia* the petals have several medial nerves and have a subterminal abaxial apiculum while the seed has a linear groove along the hilum. In inflorescence characters it resembles *B. scabra* and *B. ovata* to which species it may possibly be most closely related and for which reason it is here included in the series *Boronia*.

***Boronia purdieana*** Diels, Bot. Jahrb. Syst. 35: 318 f. 38 b, c (1904). *Type:* Near Bullsbrook, Western Australia, July, L. Diels 3564 (*holo:* B n.v., ?destroyed).

*Distribution.* This species is found near the west coast of Western Australia from Perth north to Shark Bay, with one collection from near Leonora, c. 130 km north of Kalgoorlie.

*Notes.* *Boronia purdieana* is variable in both vegetative and floral morphology, however, in anther shape and length there are clearly two groups. There is a short-anther plant, which is referred to subsp. *purdieana*, and a long-anther plant, which is referred to subsp. *callicola*. The plant that is found near Leonora has short anthers but its habitat is very different from that of the type locality of subsp. *purdieana*.

Petaline anthers  $\pm$  square, not curved, c. 0.4 mm long ..... subsp. ***purdieana***

Petaline anthers oblong, curved, c. 0.8 mm long ..... subsp. ***callicola***

***Boronia purdieana*** Diels subsp. ***purdieana***

*Distribution.* Found from near Gnangara (c. 20 km north of Perth) north to Coorow with a 1901 collection from near Busselton; recently a sizeable population was discovered near Leonora.

*Habitat.* Sandy seasonally waterlogged soil in *Banksia* woodland; however, the one collection from near Leonora was found growing on a shale and diorite hillside.

*Notes.* Diels, in his original description, records that this plant was sold in Perth as an ornamental due to its fragrant flowers.

***Boronia purdieana*** subsp. ***callicola*** Paul G. Wilson, *subsp. nov.*

A subsp. *purdieanae* antheris petalinis oblongis, incurvis, ad basim ampliatis, c. 0.8 mm longis recedit.

*Typus:* Between Pot Alley and Bluff Point, near Kalbarri, Western Australia, 1 August 1972, C. Cockman (*holo:* PERTH 00978752; *iso:* K).

*Petaline anthers* oblong, curved inward, broadened at the base, c. 0.8 mm long.

*Other specimens examined.* WESTERN AUSTRALIA: Coast road S of Red Bluff, *A.M. Ashby* 1827 (PERTH); Murchison House Station, *B. & B. Backhouse* WO 174 (PERTH); 16 miles [c. 24 km] SSE of Tamala homestead, *A.S. George* 9583 (PERTH); Kalbarri, *R.C. Wemm* 1800 (PERTH); 3 km S of Red Bluff, 1 km from coast, *P.G. Wilson* 6707 (PERTH).

*Distribution and habitat.* Found in Kalbarri National Park north to Shark Bay, Western Australia. Growing in heath and scrub in sand over limestone.

*Etymology.* The subspecific epithet is derived from the Latin words *calx*, lime, and *-cola*, -inhabitant.

***Boronia scabra* Lindl.**, Sketch Veg. Swan R. 17 (1839). *Type*: Swan River Colony, Western Australia, *J. Drummond* s.n. (*holo*: CGE).

*Distribution.* Found in south-west Western Australia from Geraldton south to Albany and east to Mt Ragged.

*Notes.* Three subspecies are recognized but their delineation is imprecise.

- 1 Flowers 4-merous; sepals glabrous to hirsute; staminal filaments smooth or tuberculate
- 2 Cymes pedunculate; staminal filaments smooth ..... subsp. ***scabra***
- 2: Cymes sessile; staminal filaments tuberculate ..... subsp. ***condensata***
- 1: Flowers 4- and 5-merous; sepals strongly hirsute; staminal filaments smooth ... subsp. ***attenuata***

***Boronia scabra* Lindl. subsp. *scabra***

*B. thymifolia* Turcz., Bull. Soc. Imp. Naturalistes Moscou 25/2: 165 (1852). *Type*: Western Australia, *J. Drummond* ser. 5, 201 (*iso*: K, TCD).

*B. fasciculifolia* F. Muell., Fragm. 1: 99 (1859). *Type*: Salt River and Fitzgerald River, Western Australia, *G. Maxwell* (*n.v.*).

*Distribution.* Found in south-west Western Australia from near Geraldton south to Gingin and from Woodanilling south to Stirling Range and east to Mt Ragged.

***Boronia scabra* subsp. *attenuata* P.G. Wilson, subsp. nov.**

Folia anguste elliptica vel teretia propter marginibus recurvos vel revolutos. Flores ad apicem ramulorum vel ad apicem pedunculorum gracilium congesti, 4- vel 5-meri. Sepala angusti triangularia, longi attenuata, c. 6 mm longa, valde hirsuta. Petala c. 8 mm longa.

*Typus*: Mt Le Grand, Western Australia, 3 October 1990, *J. Armstrong* 7051 (*holo*: PERTH 01156675).

*Leaves* narrowly elliptic to terete due to the recurved to revolute margins. *Flowers* congested at branch apices or on slender peduncles and pedicels, 4- or 5-merous. *Sepals* narrowly triangular, long-attenuate, c. 6 mm long, strongly hirsute. *Petals* c. 8 mm long. *Staminal filaments* smooth except for tuberculate swollen apex.

*Selected specimens examined.* WESTERN AUSTRALIA: Hellfire Bay, M. Carter 225 (PERTH); Cape Le Grand, J.C. Malone 5 (PERTH); Sandy Hook Island, Recherche Archipelago, 10 Nov. 1950, J.C. Willis (PERTH).

*Distribution.* Found on the south coast of Western Australia at Cape Le Grand and on the neighbouring islands of the Recherche Archipelago.

*Habitat.* Growing among granite rocks.

*Conservation status.* Although this subspecies is found in only a small area it does occur in a national park and therefore is not under threat. A Priority Two classification would be appropriate.

*Etymology.* The subspecific epithet alludes to the attenuate (Latin *attenuatus*) shape of the sepals.

*Notes.* At Cape Le Grand and on some of the islands of the Recherche Archipelago is found the variant with congested inflorescences while at Thistle Cove, c. 6 km east of Cape Le Grand, and in Cape Arid National Park is found a variant with slender peduncles and pedicels.

This subspecies is of particular interest because it frequently has alternate leaves and 5-merous flowers; for these reasons it has sometimes been assumed to be a species of *Eriostemon*.

***Boronia scabra* subsp. *condensata*** Paul G. Wilson, *subsp. nov.*

*Folia* elliptica, plana. Flores in axillis foliorum terminalium aut bracteis foliaceis breviter pedicellata. Sepala anguste elliptica vel anguste triangularia et acuminata, 4-6 mm longa, glabra vel sparse pilosa. Petala c. 8 mm longa. Filamenta staminalia glanduloso tuberculata.

*Typus:* Dinner Hill, Western Australia, 26 August 1969, K. Newbey 2861 (*holo:* PERTH 00986747).

*Leaves* elliptic, flat. *Flowers* shortly pedicellate in axils of terminal leaves or leaf-like bracts. *Sepals* narrowly elliptic or narrowly triangular and acuminate, 4-6 mm long, often open at base, glabrous or sparsely pilose. *Petals* c. 8 mm long. *Staminal filaments* glandular tuberculate.

*Other specimens examined.* WESTERN AUSTRALIA: Alexander Morrison National Park, E.A. Griffin 4725 (PERTH); Coomallo Creek, G.J. Keighery 3199 (PERTH).

*Specimens examined* of subsp. *condensata* - subsp. *scabra* intermediates. WESTERN AUSTRALIA: 15 miles [24 km] E from Mt Peron, C.A. Gardner 9426 (PERTH); 15 miles [24 km] N of Badgingarra, A.S. George 8627 (PERTH); Mt Lesueur Reserve, E.A. Griffin 4169 (PERTH).

*Distribution.* Found in the Badgingarra area of south-west Western Australia.



*Habitat.* Often growing in gravel.

*Conservation status.* This taxon is known from only a few collections, however, it is found within a national park and therefore does not require protection. A Priority Two classification would be appropriate.

*Etymology.* The subspecific epithet has reference to the compact (Latin *condensatus*) nature of the inflorescence.

*Notes.* This taxon is variable in morphology and grades into the typical subspecies. Some intermediate collections are cited above.

**1b. *Boronia* sect. *Boronia* ser. *Pedunculatae***

*Boronia* ser. *Pedunculatae* Benth., Fl. Austral. 1: 326 (1863). Type: *B. spathulata* Lindl., lectotype *fide* P.G. Wilson, Nuytsia 1: 204 (1971).

*Seed morphology.* Seed kidney-shaped, adaxial margin flat or convex. *Testa* smooth; outer testa coriaceous, glossy, black. *Hilum* linear along adaxial margin. *Raphe* a cream to pale brown pulpy mass at base of seed. *Chalazal opening* basal covered by raphe. *Placental endocarp* membranous, caducous. (Figure 3)

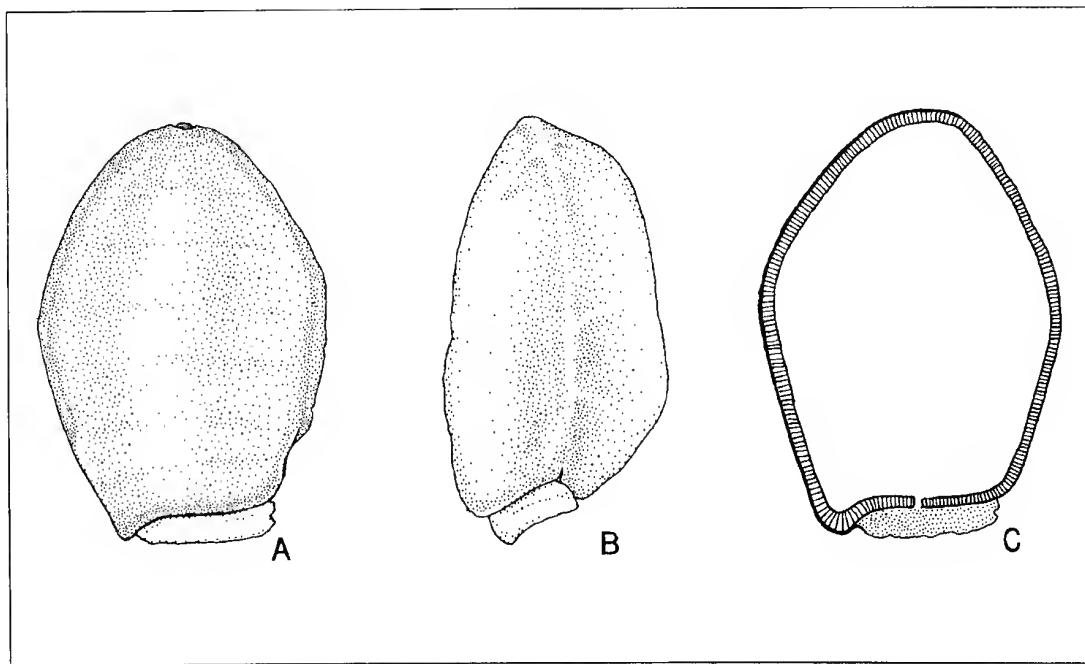


Figure 3. *Boronia dichotoma* seed. A - lateral view, B - adaxial surface, C - longitudinal radial section, all x20. Drawn from Ehrendorfer, Dec. 1966.

*Species examined.* Of the seven Western Australian species recognized in this series the following six were examined for seed characters: *Boronia anceps*, *B. denticulata*, *B. dichotoma*, *B. fastigiata*, *B. juncea*, and *B. spathulata*.

*Notes.* The principal character of note is the pulpy raphe at the base of the seed. This formation has not been observed in any other section. The seed morphology otherwise appears to grade into that found in typical members of sect. *Boronia*.

***Boronia anceps*** Paul G. Wilson, *sp. nov.*

Herba perennis, glabra, ad 60 cm alta. Rami appanati, acute 2-angulati. Folia internodiis breviora, anguste elliptica vel late obovata, 2-4 cm longa, multo reducta superiora, integra, sessilia, ad basin latiora. Flores in cymis longe pedunculati dispositi; pedicelli 5-10 mm longi, graciles, in medio bibracteolati. Sepala ovata, acuta, 3 mm longa, glabra, decidua. Petala late elliptica, c. 10 mm longa, pallido rosea, ciliata; antherae minute apiculatae. Discum integrum, angustum, glabrum. Ovarium lanosum; stylus pyramidalis vel conicus, c. 0.5 mm longus, glaber; stigma minutum.

*Typus:* 5 km north of Brennans Ford (Scott River crossing), north-east of Augusta, Western Australia, freshwater marsh, 16 November 1982, *A. Strid* 21427 (*holo:* PERTH 00946273).

*Perennial herb* to 60 cm high, glabrous, not forming a lignotuber. *Stems* flattened and ancipitous when young; internodes c. 6 cm long. *Lower leaves* sessile, obovate, c. 2 cm long; upper leaves narrowly oblong to narrowly ovate; uppermost narrowly oblong to linear, usually very reduced. *Inflorescence* a terminal pedunculate cyme; peduncle slender, to 6 cm long, bracts caducous; pedicels slender and smooth, 5-10 mm long. *Sepals* imbricate, broadly ovate to narrowly triangular, 2-4 mm long, glabrous or woolly ciliate, dark red. *Petals* imbricate, broadly ovate, c. 8 mm long, acuminate, glabrous, pink. *Stamens* all fertile; sepaline filaments very narrowly oblong with a clavate apex, verrucose abaxially, ciliate below; petaline filaments similar but slightly shorter; anthers affixed subapically on a very short stipe to adaxial side of filament, c. 1.8 mm long with a small rounded white apiculum. *Disc*, 1 mm high, equal in width to ovary, glabrous. *Carpels* glabrous or shortly woolly pilose; style and stigma continuous, columnar or conical, 1-1.5 mm long, glabrous or sparsely pilose at base. *Cocci* oblong, c. 3.5 mm long. *Seeds* oblong-ellipsoid, c. 2.5 mm long; outer testa smooth, glossy black. (Figure 4)

*Selected specimens examined.* WESTERN AUSTRALIA: Boggy Lake, 27 Dec. 1957, *D. Churchill* (PERTH); Scott River road, *S. Paust* 265 (PERTH); Scott National Park, *C.J. Robinson* 505 (PERTH).

*Distribution and habitat.* Found in the extreme south-west of Western Australia between Scott River and Walpole. Grows in seasonally swampy heaths.

*Conservation status.* Although this species is known from a relatively small area some of the populations are in a national park. A Priority Three code is therefore probably appropriate.

*Etymology.* The Latin word *anceps* means two-edged and in this case refers to the shape of the stem.

*Notes.* *Boronia anceps* is evidently closely related to *B. fastigiata* and to *B. spathulata*; it differs from both in having flattened ancipitous upper internodes and apparently in lacking a lignotuber.

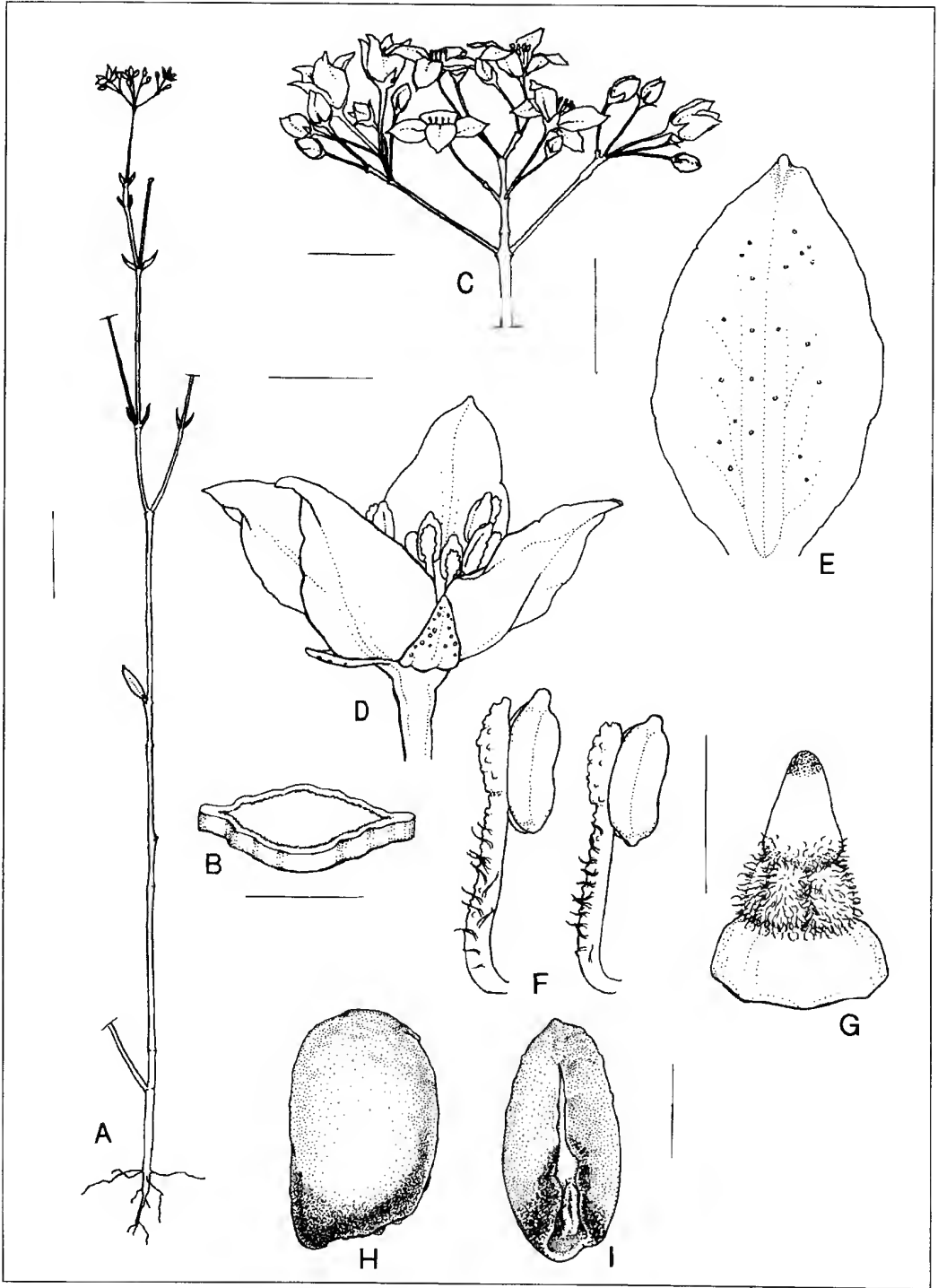


Figure 4. *Boronia anceps* A - whole plant, B - T.S. stem, C - inflorescence, D - flower, E - petal, F - sepaline and petaline stamens, G - disc and pistil, H - lateral view of seed, I - adaxial surface of seed. Scale bars: 5 cm (A), 2 mm (B,E,F and G), 10 mm (C), 3 mm (D), 1 mm (H,I). Flowering illustrations drawn from *C.J. Robinson* 505, seed from *A. Strid* 21427.

**Boronia denticulata** Sm., Trans. Linn. Soc. London 8: 284 (1807). *Type*: King George Sound, Western Australia, 1803, *A. Menzies* (*holo*: LINN, photo seen).

*B. chironiifolia* Bartl. in Lehm., Pl. Preiss. 1: 167 (1844). *Type*: "In uliginosis sylvae 17 mill. ab urbicula Albany (Plantagenet)" [Albany, Western Australia], 9 November 1840, *L. Preiss* 2027. (*lecto*: LD; *isolecto*: MEL 1058492), lectotype here chosen.

? *B. hypericifolia* Regel, Gartenfl. 6: 152 (1857), *ex desc.*

*Note*. Regarding the date of collection of the Menzies specimen cited above see note under *B. crenulata*.

**Boronia dichotoma** Lindl., Edwards's Bot. Reg. 27: sub tab. 47 (1841). *Type*: Vasse River, Western Australia, *Mr Molloy* (*holo*: CGE, photo seen).

*B. spatulata* var. *elatio*r Benth., Fl. Austral. 1: 327 (1863). *Type citation*: *B. dichotoma*, Lindl. Bot. Reg. 1841, under n. 47. - Vasse river, *Mrs. Molloy*; Swan River, *Drummond*, Coll. 1843, n. 38. *Type*: Vasse River, Western Australia, *Mrs Molloy* (*syn*: K, photo seen); Swan River Colony, Western Australia, *J. Drummond* 38 (*syn*: PERTH).

*B. flexuosa* Bartl. in Lehm., Pl. Preiss. 1: 166 (1844). *Type*: "In arenosis sylvae ad fluvium Canning (Perth) et in districtu Sussex" [Canning River, Perth, Western Australia], 5 December 1839, *L. Preiss* 2024 (*lecto*: LD; *isolecto*: MEL 1058504, MEL 1058505), lectotype here chosen.

*B. integrifolia* Domin, Vestn. Kral. Ceske Spolecn. Nauk, Tr. Mat.-Prir. 2: 53 (1923). *Type citation*: W.A.: coll. A.A. Dorrien-Smith (herb. Kew). *Type*: Bridgetown to Kojonup and Slab Hut Gully, Western Australia, 1910, *A.A. Dorrien-Smith* (*lecto*: K) lectotype here chosen.

*Notes*. *Boronia dichotoma* is readily recognized by the glandular aculeate processes that are found on the pedicels and to a lesser extent the peduncles and terminal portions of the stems. The leaves vary from being obovate (c. 2 cm long) towards the base of the stem to slender-terete (c. 4 cm long) below the inflorescence. The stems are slender and the internodes very long, the upper ones up to 12 cm long.

The type of *B. integrifolia* differs from material otherwise included in *B. dichotoma* in having relatively small glandular aculeate processes; it also differs in all the leaves being elliptic and 6-12 mm long with the upper internodes only slightly exceeding them. The district in which the type is stated to have been collected is 50-100 km east of any other record for *B. dichotoma*. *Boronia integrifolia* could be recognized as a distinct taxon, but it is possible that the type is a hybrid between *B. dichotoma* and *B. fastigiata* or between *B. dichotoma* and another member of *Boronia* ser. *Pedunculatae*.

**Boronia exilis** Paul G. Wilson, *sp. nov.*

*B. juncea*e subsp. *laniflorae* (Bartl.) Paul G. Wilson affinis, a qua imprimis differt pedicellis longioribus, staminibus pilis rigidis manifeste ciliatis.

*Typus*: Scott National Park, Western Australia, 17 September 1990, *C.J. Robinson* 127 (*holo*: PERTH 3054810; *iso*: CANB).

Erect slender-stemmed *perennial* c. 1 m high. Branches glabrous; internodes 2-5 cm long. Lower leaves caducous, not seen; medial and upper leaves slender, semiterete, channelled above, 1-1.5 cm long, much shorter than internodes, glabrous or sparsely woolly on midrib, caducous. Flowers 3-9 in terminal umbelliform cymes; bracts elliptic, c. 5 mm long, woolly ciliate, caducous; pedicels 5-12 mm long, somewhat woolly; bractcoles basal, scarious, caducous. Sepals oblong-elliptic, acute, c. 4 mm long, dark red, woolly on both surfaces, densely woolly ciliate, deciduous in fruit. Petals broadly obovate with broad claw, c. 7 mm long, rounded at apex, sparsely woolly on midrib and within, pink. Staminal filaments terete above, flattened towards base, glandular-verrucose at swollen apex, prominently hirsute ciliate; anthers subapically affixed, c. 1.2 mm long, shortly white-apiculate. Disc cushion-shaped, glabrous. Ovary glabrous; style terete, glabrous, c. 1.5 mm long; stigma minute. (Figure 5)

*Specimens examined.* WESTERN AUSTRALIA: 9 miles [14 km] E of Karridale, A.C. Beauglehole 12564 (PERTH); "Port Augusta near Geographe Bay" [Augusta], 1881, Miss Bunbury (MEL); Scott River, E. Mattiske 370 (PERTH); Scott National Park, C.J. Robinson 049 (PERTH).

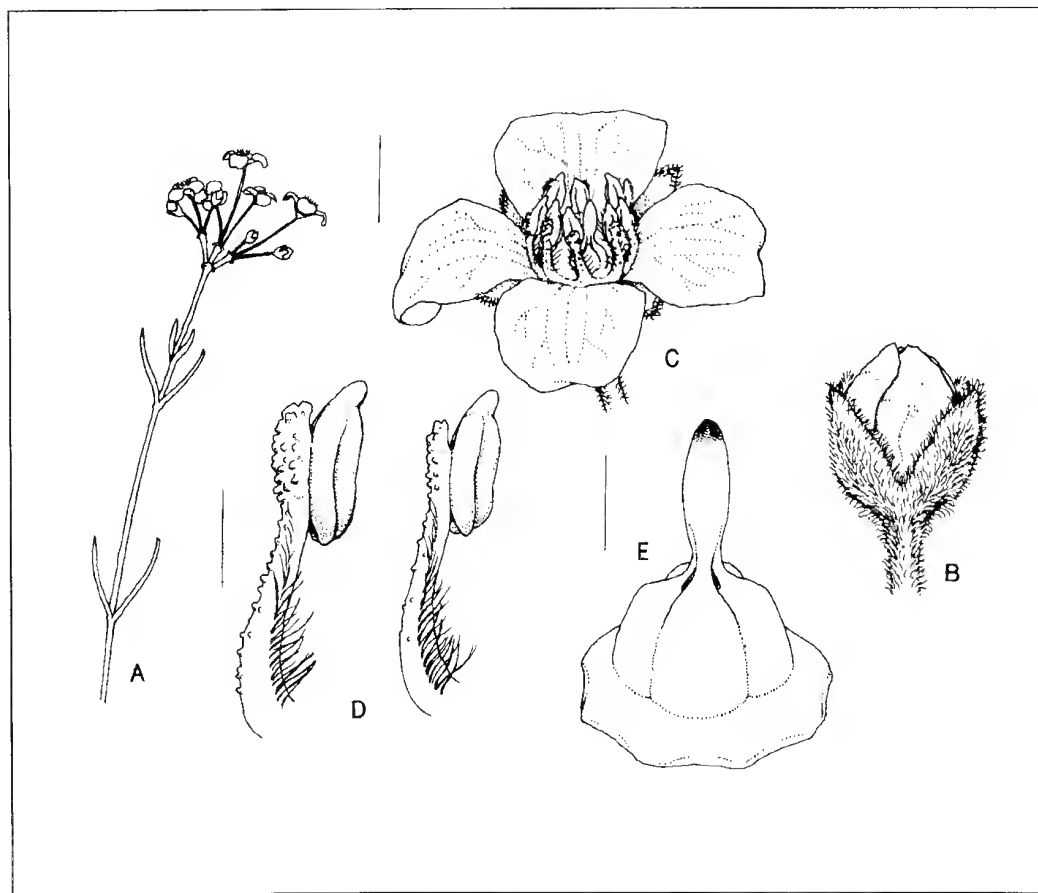


Figure 5. *Boronia exilis* A - flowering stem, B - bud, C - flower, D - sepaline and petaline stamens, E - disc and pistils. Scale bars: 20 mm (A), 3 mm (B,C), 0.5 mm (D), 1 mm (E). Drawn from C.J. Robinson 049.

*Distribution.* Known only from the Scott River area, extreme south-west of Western Australia.

*Habitat.* Growing in seasonally wet heath.

*Conservation status.* Classified as Declared Rare Flora, it is only known from a few sites over a small area.

*Etymology.* The Latin word *exilis*, meaning slender and weak, refers to the slender stems of this species.

*Notes.* This species is similar to *Boronia juncea*, particularly to the subsp. *laniflora*; it differs most obviously from that species in having strongly ciliate staminal filaments (in *B. juncea* they are glabrous).

***Boronia fastigiata*** Bartl. in Lehm., Pl. Preiss. 1: 167 (1844). *Type:* "In locis hieme inundatis districtus Plantagenet" [Albany area], Western Australia, November 1840, *L. Preiss* 2028 (*lecto:* LD; *isolecto:* MEL), lectotype here chosen.

*Distribution.* Found in south-west Western Australia from Perth to the south coast as far east as Albany.

*Notes.* Two subspecies are recognized.

Branchlets terete ..... subsp. **fastigiata**

Branchlets with four very narrow glandular undulate wings ..... subsp. **tenuior**

***Boronia fastigiata* Bartl. subsp. *fastigiata***

*Branchlets* terete. *Leaves* narrowly to broadly elliptic or obovate, 1-2(3) cm long, entire or almost so. *Cymes* mostly terminal to long branches. *Pedicels* of lateral flowers of cyme with a pair of extremely minutely bracteoles or incipient buds at base.

*Distribution.* Found in south-west Western Australia from Perth to Collie and from there south-east to Kojonup and Albany.

*Habitat.* Collectors' notes indicate that it occurs in lateritic gravel.

*Notes.* This subspecies is similar in its inflorescence and in its floral characters to *B. barkeriana* from New South Wales.

The type of *B. fastigiata* is of a variant with leaves crowded (the internodes c. 4 mm long), broadly elliptic, 6-9 mm long, and serrate. It was collected in the Plantagenet county which encompasses the area around Albany, Denmark, and the Stirling Range. The specimen matches material collected between Slab Hut Creek and Cranbrook by Capt. A. Dorrien Smith in 1910 and near Kojonup by W.E. Blackall in 1933. All recent collections of subsp. *fastigiata* have come from between Perth and Collie suggesting that it no longer occurs further south. Some collections from near Albany are intermediate between this subspecies and *B. denticulata*.

***Boronia fastigiata* subsp. *tenuior* (Benth.) Paul G. Wilson, *stat. nov.***

*B. fastigiata* var. *tenuior* Benth., Fl. Austral. 1: 327 (1863). *Type citation*: Western Australia, Gilbert, n. 3 and 18. *Type*: Australind, Western Australia, 1842, J. Gilbert 3 (*lecto*: K), lectotype here chosen.

*B. tenuior* Domin, Vestn. Kral. Ceske Spolecn. Nauk, Tr. Mat.-Prir. 2: 52 (1923). *Type*: Yalingup and Cape Naturaliste, Western Australia, 1910, A.A. Dorrien-Smith (*holo*: K).

*Branchlets* with four very narrow glandular-undulate wings; *Leaves* narrowly to broadly elliptic, 15-20 mm long, mostly serrate. *Cymes* terminal to main and lateral branchlets. *Pedicels* of lateral flowers of cyme without incipient buds or bracteoles.

*Distribution*. Found in south-west Western Australia from Busselton south to Augusta and east to Nannup and Walpole. Occurs along streams and in seasonally damp wet areas.

*Notes*. Near the south coast the leaves are narrowly elliptic whereas further north they are elliptic to broadly elliptic.

The types of both *B. tenuior* and of *B. fastigiata* var. *tenuior* have leaves well-spaced (the internodes 10-20 mm long), narrowly elliptic, 10-15 mm long, and serrate. A variant found in the Harvey River district has slender branches with the internodes 25-45 mm long and obovate entire leaves 15-20 mm long.

***Boronia juncea* Bartl. in Lehm., Pl. Preiss. 1: 166 (1844).** *Type*: Wellington district, Western Australia, 5 December 1839, L. Preiss 2036 (*lecto*: LD), lectotype here chosen.

*Distribution*. Found in the far south-west of Western Australia.

*Notes*. Four subspecies are recognized but these evidently grade into each other.

- 1 Pedicels and sepals glabrous ..... subsp. **juncea**
- 1: Pedicels and sepals sparsely to densely woolly
- 2 Sepals 1.5-3 mm long, acute ..... subsp. **minima**
- 2: Sepals 3-5 mm long with acuminate to subulate apex
- 3 Petal apex acuminate ..... subsp. **micrantha**
- 3: Petal apex rounded and apiculate ..... subsp. **laniflora**

***Boronia juncea* Bartl. subsp. *juncea***

*Plant* glabrous. *Pedicels* c. 3 mm long, glabrous. *Sepals* narrowly triangular with subulate-acuminate apex, c. 2.5 mm long, glabrous. *Petals* obovate, acuminate, c. 4 mm long, glabrous. (Figure 6A)

*Distribution*. Found between Bunbury and Mandurah, south-west Western Australia.

*Habitat*. Growing in low scrub in sand.

*Notes.* In the strict sense this subspecies is only known from a few collections all from the same locality about 27 km north of Bunbury. Its distribution is therefore evidently quite separate from that of the other subspecies. However, material of *B. juncea* from the Pemberton to Donneybrook area, that is here referred to subsp. *minima*, is somewhat intermediate in morphology between the types of subsp. *juncea* and subsp. *minima*.

***Boronia juncea* subsp. *laniflora*** (Bartl.) Paul G. Wilson, *stat. nov.*

*Boronia laniflora* Bartl. in Lehm., Pl. Preiss. 1: 165 (1844). *Type:* Between Mt Melville and Mt Elphinstone, 11 October 1840, *L. Preiss* 2030 (*syn:* MEL); Sussex District, Western Australia, December 1839, *L. Preiss* 2037 (*lecto:* LD), lectotype here chosen.

*Boronia laniflora* var. *macrantha* Bartl. in Lehm., Pl. Preiss. 1: 165 (1844). *Type:* Sussex District, Western Australia, December 1839, *L. Preiss* 2037 (*lecto:* LD), lectotype here chosen.

*Branches and leaves* glabrous or very sparsely woolly. *Pedicels* woolly, 2-5 mm long. *Sepals* triangular, acuminate, c. 4 mm long, woolly. *Petals* broadly obovate with rounded apiculate apex, c. 7 mm long, very sparsely woolly along midrib outside, sparsely woolly within. *Ovary* glabrous. (Figure 6B)

*Distribution.* Found near the south coast of Western Australia between Augusta and Walpole and also near Albany.

*Habitat.* Growing in seasonally swampy soil.

*Nomenclatural note.* Bartling did not cite collections after his description of *B. laniflora*, but he did after the descriptions of each of his two varieties, *micrantha* and *macrantha*. I have based the name *B. laniflora* on the type of var. *macrantha*.

***Boronia juncea* subsp. *micrantha*** (Bartl.) Paul G. Wilson, *stat. et comb. nov.*

*Boronia laniflora* var. *micrantha* Bartl. in Lehm., Pl. Preiss. 1: 165 (1844). *Type:* Between Mt Melville and Mt Elphinstone, Western Australia, 11 October 1840, *L. Preiss* 2030 (*iso:* MEL 711185).

*Branches and leaves* glabrous or very sparsely woolly. *Pedicels* sparsely woolly, 2-5 mm long. *Sepals* narrowly triangular, acuminate, 5-6 mm long, sparsely woolly. *Petals* obovate, acuminate, 5-7(10) mm long, very sparsely woolly along midrib outside, sparsely woolly within. *Ovary* somewhat woolly. (Figure 6C)

*Distribution.* Found near the south coast of Western Australia between Albany and Walpole.

*Habitat.* Growing in seasonally swampy situations.

***Boronia juncea* subsp. *minima*** Paul G. Wilson, *subsp. nov.*

Rami et folia glabra. Pedicelli sparse lanati, 1-2.5 mm longi. Sepala ovata vel triangularia, acuta, 1.5-3 mm, longa, sparse lanata. Petala obovata, acuminata vel apiculata, c. 3 mm longa, glabra vel secus costam sparse lanata.



*Typus*: Scott River, Western Australia, 15 November 1978, *E. Wittwer* 2218 (*holo*: PERTH 00957097).

*Branches and leaves* glabrous. *Pedicels* sparsely woolly, 1-2.5 mm long. *Sepals* ovate to triangular, acute, 1.5-3 mm long, sparsely woolly. *Petals* obovate, acuminate or apiculate, c. 3 mm long, glabrous or sparsely woolly along midrib. (Figure 6D)

*Selected specimens examined*. WESTERNAUSTRALIA: 4 miles [c. 6.4 km] S of Northcliffe, *T.E.H. Aplin* 1416 (PERTH); 26 miles [42 km] E of Augusta, *E.M. Bennett* 2834 (PERTH); Chudalup, *W.M. McArthur* 7 (PERTH); Scott National Park, *C.J. Robinson* 005 (PERTH); 3-5 km from Windy Harbour, *A. Strid* 21459 (PERTH); Donnybrook Sunklands, *P.G. Wilson* 11638 (PERTH).

*Distribution*. Found in south-west Western Australia between Margaret River and Augusta and east to Northcliffe.

*Habitat*. Growing in seasonally swampy areas.

*Conservation status*. This subspecies is known from a number of populations some of which are in national parks; it is therefore not at risk.

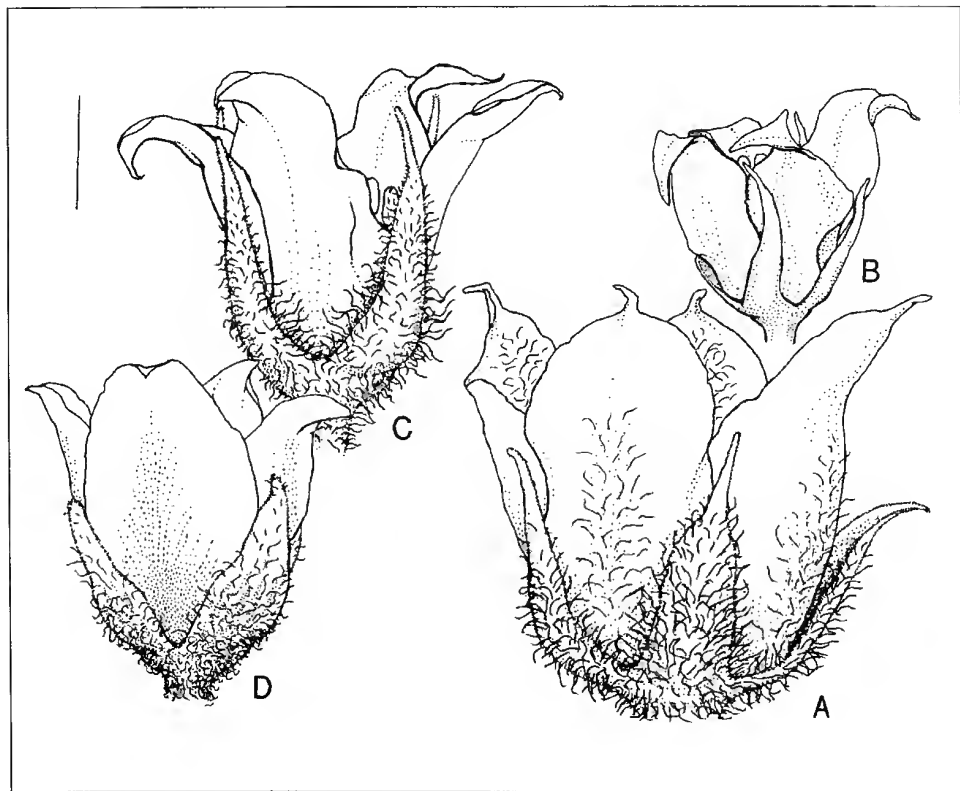


Figure 6. *Boronia juncea* flowers. A - subsp. *laniflora* (*H. Demarz* 6647), B - subsp. *juncea* (*D. Woodman* 184), C - subsp. *micrantha* (*E.J. Croxford* 2920), D - subsp. *minima* (*N. Gibson*). Scale bar = 2 mm.

*Etymology.* The Latin *minimus* refers to the small flowers of this subspecies.

***Boronia molloyae*** J. Drumm. in Hook., London J. Bot. 2: 169 (1843) as *Molloyi*. *Type:* Between the Vasse River and Augusta, Western Australia, *J. Drummond* (*n.v.*).

*B. elatior* Bartl. in Lehm., Pl. Preiss. 1: 170 (1844). *Type:* “In humosa-arenosis humidis inter frutices densos vallis jugi montium Darling’s range (Perth)” [Darling Range, Perth, Western Australia], September 1841, *L. Preiss* 2013 (*lecto:* LD; *isolecto:* MEL 725044, 725045), lectotype here chosen.

*B. semifertilis* F. Muell., Fragm. 2: 98 (1860). *Type:* Franklin River, Western Australia, *G. Maxwell* (*n.v.*).

***Boronia spathulata*** Lindl., Sketch Veg. Swan R. 17 (1839). *Type:* Swan River Colony, Western Australia, *J. Drummond* (*holo:* CGE photo seen).

*B. macra* Bartl. in Lehm., Pl. Preiss. 1: 167 (1844). *Type:* Near Mahogany Creek, Darling Range, Western Australia, 13 September 1839, *L. Preiss* 2026 (*lecto:* LD), lectotype here chosen.

*B. spathulata* var. *ramosa* Benth., Fl. Austral. 1: 327 (1863). *Type:* Swan River Colony, Western Australia, *J. Drummond* s.n. (*syn:* MEL); East Mt Barren, Western Australia, *G. Maxwell* (*syn:* MEL).

*Distribution.* Found in the south-west of Western Australia from Perth south to Augusta and east to Israelite Bay.

*Notes.* This species may be readily distinguished from similar species by the open cymose inflorescence, the bracteolate pedicels (of which the upper portion is fleshy and glandular punctate), and the slender sparsely pilose style.

***Boronia tetragona*** Paul G. Wilson, *sp. nov.*

Herba perennis, glabra, ad 70 cm alta. Rami tetragoni, angulis acutis, laevibus. Folia internodiis breviora, sessilia, integra, marginibus dense papillois, multo reducta superiora, inferiora remota elliptica, superiora ovata, summa triangularia. Flores in umbellis pedunculatis dispositi; pedicelli c. 10 mm longi, graciles, ebracteolati, rubri. Bractee caducae. Sepala ovata, 3 mm longa, glabra, lanato-ciliata, decidua. Petala late elliptica, c. 7 mm longa, pallido rosea, ad apice rotundata; antherae minutissimae apiculatae. Ovarium glabrum; stylus columnaris vel clavatus, c. 1 mm longus, glaber; stigma hemisphericum, brunneum.

*Typus:* Western Australia, Ambergate Reserve, south-west of Busselton, 3 November 1993, *G.J. Keighery* 12938 (*holo:* PERTH 04566475).

*Perennial herb* to 70 cm high, glabrous, not forming a lignotuber. *Stems* tetragonous when young; internodes mostly 4–12 cm long. *Leaves* sessile, diminishing in size towards apex, with densely papillate margins; middle and lower leaves elliptic, to 4 cm long; upper leaves ovate; uppermost leaves narrow triangular. *Inflorescence* a terminal pedunculate umbel; peduncle slender, to 2 cm long, bracts caducous; pedicels slender and smooth, c. 1 cm long, dark red. *Sepals* open or slightly imbricate, ovate c. 3 mm long, slightly woolly ciliate, dark red, deciduous. *Petals* imbricate, broadly elliptic, c. 7 mm long, rounded at apex, glabrous, pink with red medial stripe on abaxial side. *Stamens* all fertile; sepaline filaments very

narrowly oblong with a clavate apex, verrucose abaxially, sparsely ciliate below; petaline filaments similar but slightly shorter; anthers affixed subapically on a very short stipe to adaxial side of filament, *c.* 1 mm long with a minute rounded white apiculum. *Disc c.* 1 mm high, equal in width to ovary, glabrous, dark red. *Ovary* glabrous; style columnar or clavate, 1 mm long, glabrous; stigma hemispherical, *c.* 0.2 mm long, brown. *Fruit* not seen.

*Specimens examined.* WESTERN AUSTRALIA: Capel Nature Reserve, 1 km W of Capel, *G.J. Keighery* 13635 (PERTH); Ambergate Regional Park, SW of Busselton, *G.J. Keighery* 14809 (PERTH); 7 km W of Capel, *R. Pullen* 9845 (PERTH); Whicher Range, *P.G. Wilson* 11640 (PERTH).

*Distribution.* Found in the south-west of Western Australia between Capel and the Whicher Range.

*Habitat.* Recorded by Keighery as growing in *Melaleuca preissiana* and *Corymbia calophylla* open woodland as well as in *Pericalymma* woodland over sedges, in brown sandy loam in winter-wet flats.

*Conservation status.* Although this species is known from a relatively small area, two of the populations are in reserves and therefore a Priority Three code is probably appropriate.

*Etymology.* The Greek words *tetra*, four, and *gonia*, angle, refer to the four-angled branchlets.

*Notes.* *Boronia tetragona* is similar to *B. fastigiata* subsp. *tenuior* from which it differs in having sessile entire leaves, smooth sharply angled branches (the ribs not glandular-undulate), woolly ciliate (not glabrous) sepals, and rounded (not acute) apices to the petals. The leaves of *B. tetragona* are somewhat unusual in that their margins are densely papillate, not smooth as is found in those species that appear to be closely related.

## 2. *Boronia* sect. *Imbricatae* Engl.

*Boronia* sect. *Imbricatae* Engl., Nat. Pflanzenfam. 3/4: 136 (1896). *Type:* *Boronia cymosa* Endl.; lectotype *fide* P.G. Wilson, Nuytsia 1: 204 (1971).

*Seed morphology.* *Seed* kidney-shaped. *Testa* rugulose; outer testa membranaceous, surface margaritaceous (shiny grey) flecked with black spots on ridges. *Adaxial surface* slightly concave and largely occupied by large ovate, smooth cream aril scar. *Hilum* linear along centre of aril scar. *Raphe* small on lower adaxial margin with reddish brown cover. *Chalazal opening* on lower adaxial margin covered by raphe. *Aril* ovate, firm, cream coloured, attached to seed at aril scar. *Placental endocarp* thin, deciduous. (Figure 7)

*Notes.* This section is here regarded as being monotypic. It has a seed unlike that found in any other section of the *Boroniaceae*.

Engler (1896) included five series under the sect. *Imbricatae* into which he placed species from each of the sections here recognized, apart from those in sect. *Valvatae*. It has been lectotypified in a manner that excludes all but one of the taxa included by Engler.

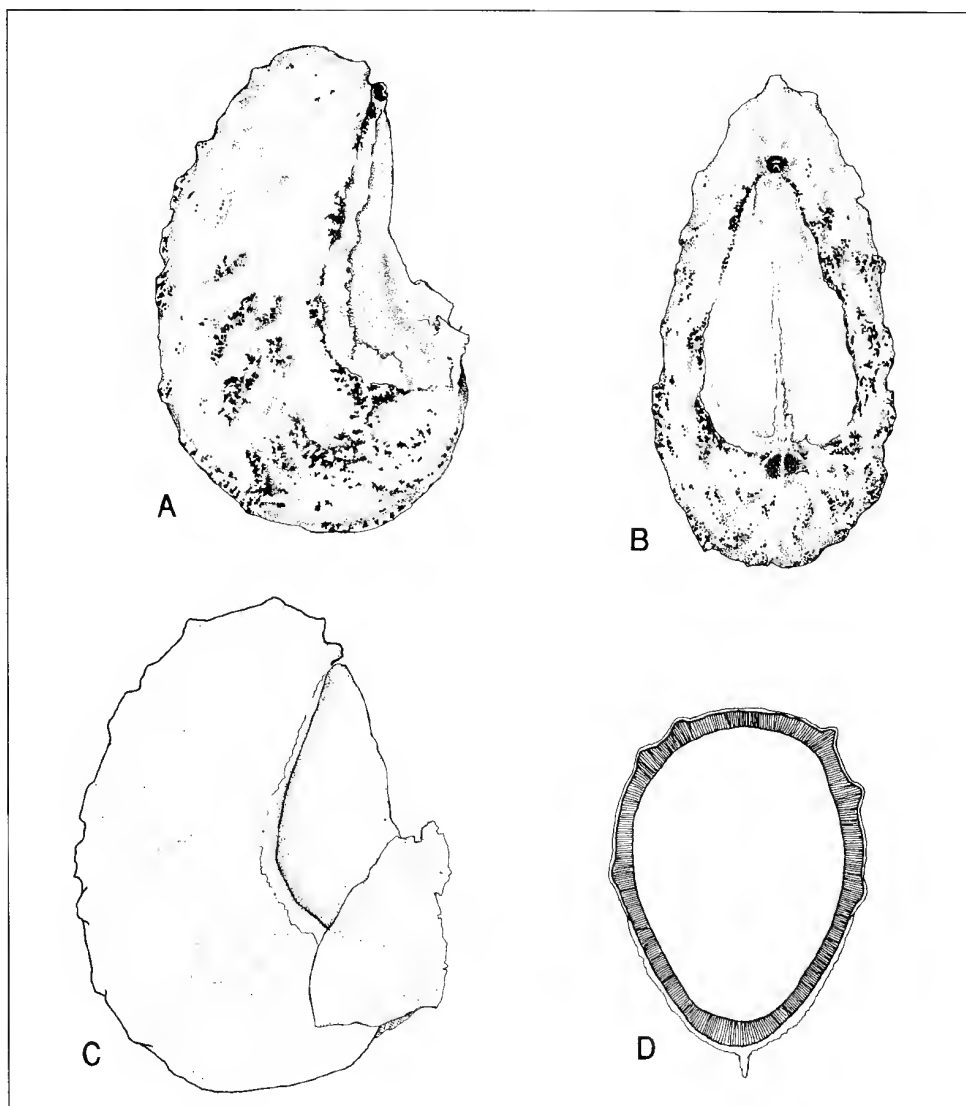


Figure 7. *Boronia cymosa* seed. A - lateral view, B - adaxial surface, C - lateral view with endocarp and aril attached, D - transverse section, all x20. Drawn from E.A. Griffin 1610.

### 3. *Boronia* sect. *Valvatae* s. lat.

*Boronia* sect. *Valvatae* (Benth.) Engler, Nat. Pflanzenfam. 3/4: 135 (1896). - *Boronia* ser. *Valvatae* Benth., Fl. Austral. 1: 308, 311 (1863). - *Boronia* sect. *Valvoboronia* Kuntze, *nom. illeg.* in T. Post & Kuntze, Lex. Gen. Phan. 74 (1903), based on preceding. *Type*: to be designated.

*Boronia* subg. *Robonia* Rehb., Iconogr. Bot. Exot. 54 (1824). *Type*: *B. ledifolia* (Vent.) J. Gay ex DC.

*Typification.* This section is being revised by Marco Duretto (MEL) who will designate a lectotype.

*Seed morphology.* Seed kidney-shaped, adaxial margin flat or concave. *Testa* smooth, outer testa matt, minutely papillose, black. *Hilum* linear along adaxial margin, sometimes faint. *Raphe* small on lower adaxial margin and at base of seed, with glossy brittle cover. *Chalazal opening* basal or sub-basal covered by raphe. *Placental endocarp* usually thick and persistent acting as an elaiosome. (Figure 8)

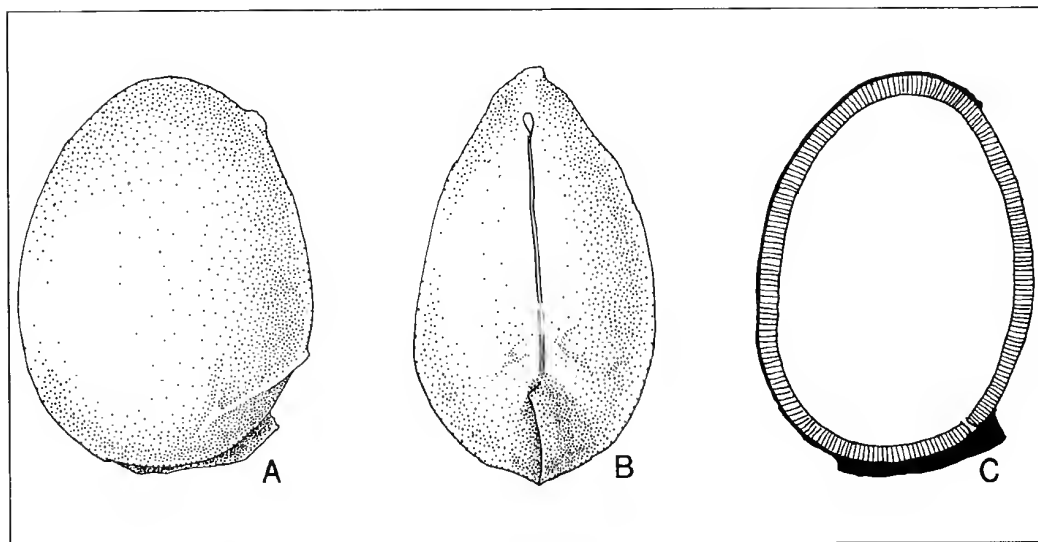


Figure 8. *Boronia alata* seed. A - lateral view, B - adaxial surface, C - longitudinal radial section, all x20.

*Species examined.* Both the number of species and the circumscription of this section are still to be determined. However, as presently defined, the section includes the following species whose seed morphology was examined: *Boronia alata*, *B. algida*, *B. lanceolata*, and *B. ternata*.

*Notes.* The seed of this section is characterized by the matt outer testa, the linear hilum, and the frequently thick persistent placental endocarp.

***Boronia corynophylla* Paul G. Wilson, *sp. nov.***

Ramuli sparse et minute puberuli. Folia anguste teretia vel anguste fusiformia, 7-10 mm longa, modice curvata, minute puberula. Flores 1-3 terminales. Pedicellus crassus, 1-2 mm longus, ad basim bracteolatus. Sepala imbricata, ovata, 2.5-3 mm longa, atro rufescentia. Petala valvata, coriacea, ovata, c. 5 mm longa, acuta, pallido rubra, glabrescentia, apicem non inflexa, non apiculata. Filamenta staminalis: antesepalina clavata, truncata, apicem versus verrucosa, ciliata; antepetalina crassa, oblonga, ad apicem verrucosa, ciliata; antherae minute apiculatae. Discum integrum, glabrum. Ovarium minute puberulum; stylus et stigma continuum, cylindraceum vel clavatum, c. 1 mm longum, obtusum, basin versus pilosum.

*Typus:* 13 km south-west of 90 Mile Tank, Frank Hann National Park, 27 October 1980, K.R. Newbey 7827 (*holo:* PERTH 01258486).

Spreading, densely branched *shrub* c. 30 cm high. *Branchlets* terete, sparsely and minutely puberulous all over when young with antrorse curved hairs; cuticle soon exfoliating and forming a grey scurfy covering. *Leaves* slender-terete to narrowly fusiform or narrowly clavate, slightly curved,

7-10 mm long, *c.* 1 mm wide, obtuse, slightly flattened above and sometimes sulcate, very minutely puberulous with antrorsely curved hairs. *Flowers* 1-3 terminal to branches. *Pedicel* thick, 1-2 mm long, sparsely and minutely puberulous, with a pair of small (*c.* 1 mm long) ovate bracteoles near the base. *Sepals* imbricate, ovate, 2.5-3 mm long, two narrower and slightly longer, coriaceous, glandular punctate, dark reddish brown, glabrous to very sparsely puberulous, ciliate. *Petals* valvate, leathery, ovate, *c.* 5 mm long, acute, pale red, glabrous to very sparsely and minutely puberulous outside, puberulous within, prominently glandular-punctate all over; apex neither inflexed nor sub-apically apiculate. *Stamens* all fertile; sepaline filaments clavate, *c.* 2 mm long, obliquely truncate, warty in upper half, ciliate; petaline filaments thick, oblong, *c.* 1.5 mm long, warty at apex, ciliate; anthers cordate, pale yellow, *c.* 0.8 mm long, with broad connective, loculi not reflexed at dehiscence, minutely white-apiculate, affixed by a minute sub-apical stipe to adaxial side of filaments. *Disc* a narrow entire ring, glabrous. Ovary hemispherical, *c.* 1 mm high, minutely puberulous. *Style* and stigma continuous, cylindrical to somewhat clavate, *c.* 1 mm long, obtuse, pilose in lower half. *Fruit* and seed not seen. (Figure 9)

*Additional specimen examined.* WESTERN AUSTRALIA: 13 km SW of 90 Mile Tank, Frank Hann National Park, 11 Nov. 1979, K. Newbey 6477 (PERTH).

*Distribution.* This species has only been recorded from Frank Hann National Park, *c.* 90 km north-east of Lake King township, Western Australia.

*Habitat.* Found in *Eucalyptus salmonophloia* open woodland on well-drained clayey sand.

*Conservation status.* This species is known from only one locality where, according to the collector (K.R. Newbey), it is very common. An attempt was made in 1996 to re-collect this species but it could not be found, probably due to a fire having passed through the area the previous year. A Priority Two classification with priority for survey would probably be appropriate for this species.

*Etymology.* The specific epithet is derived from the Greek words *coryne*, a club, and *phyllon*, a leaf, with reference to the shape of the leaves.

*Notes.* *Boronia corynophylla* is distinctive because of the shape of its leaves and the exfoliating cuticle on its branches which gives the plant a glaucous appearance. The valvate aestivation of the petals is interesting since the sepals are imbricate. This situation is also found in *B. algida*, a species of south-eastern Australia, and with which *B. corynophylla* is probably most closely related (M. Duretto, pers. com.). Seed is required to positively determine its sectional position.

#### 4. *Boronia* sect. *Cyanothamnus*

*Boronia* sect. *Cyanothamnus* (Lindl.) F. Muell., *Fragm.* 9: 113 (1875). - *Cyanothamnus* Lindl., *Sketch Veg.* Swan R. Col. 18 (1839). - *Boronia* ser. *Cyaneae* Benth., *Fl. Austral.* 1: 309 (1863) based on *Cyanothamnus* Lindl. - *Boronia* sect. *Cyaneae* (Benth.) De Wild., *nom. illeg.*, *Icon. Select.* 2: 67 (1901). *Type:* *B. ramosa* (Lindl.) Benth., lectotype here chosen.

*Typification.* The two species of *Cyanothamnus* that were described by Lindley, *C. ramosus* and *C. tenuis*, are currently included in *Boronia* sect. *Cyanothamnus*; the one that is most widespread is selected as lectotype.

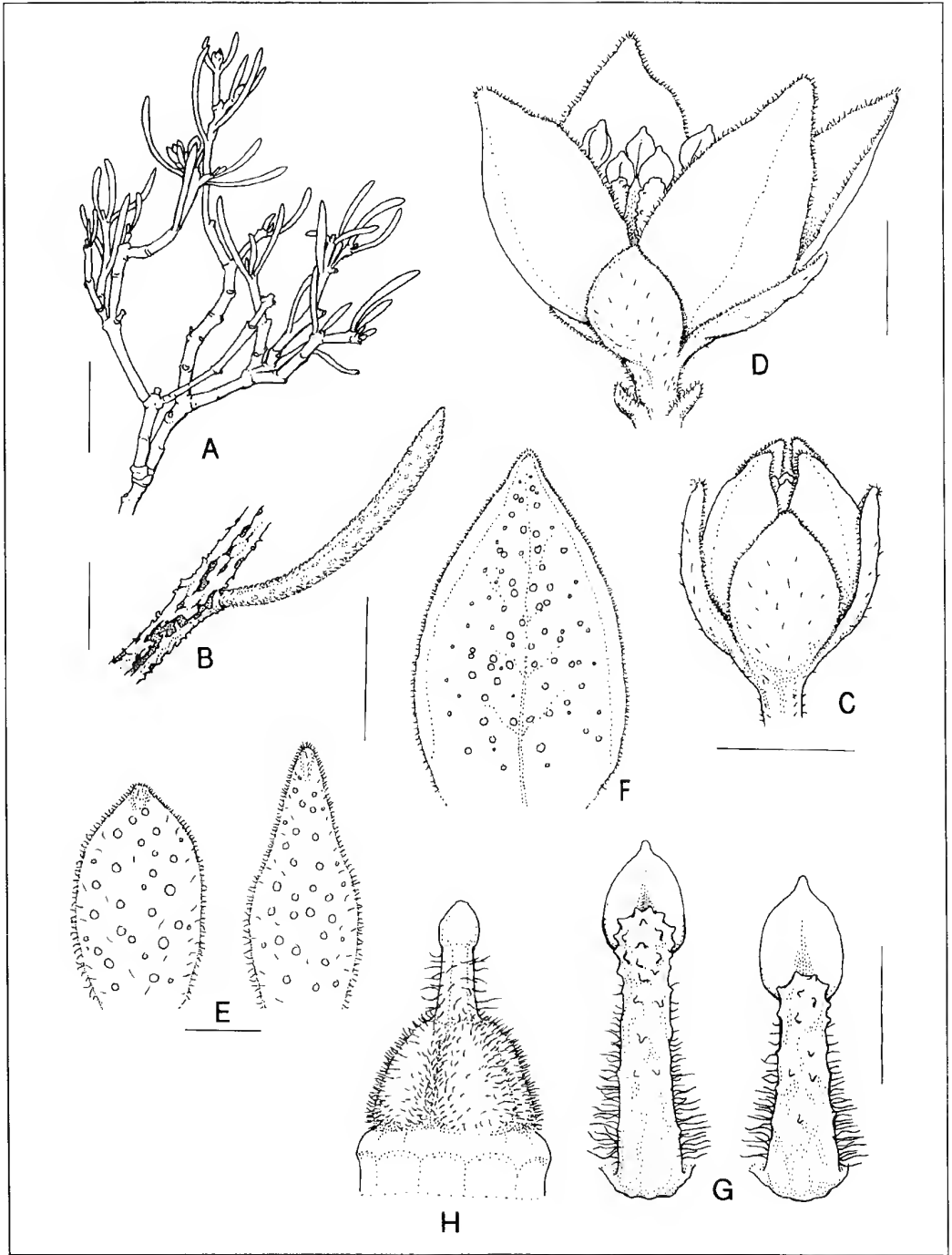


Figure 9. *Boronia corynophylla* A - flowering branch, B - leaf and branchlet, C - flower bud, D - flower, E - sepals, F - petal, G - sepaline and petaline stamens, H - disc and pistil. Scale bars: 10 mm (A), 2.5 mm (B), 2 mm (C,D and F), 1 mm (E,G and H). Drawn from K. Newbey 7827.

*Seed morphology.* Seed kidney-shaped, adaxial margin flat or convex. *Testa* rugose; outer testa diaphanous, black usually with grey powdery areas between ridges. *Hilum* linear along adaxial margin. *Raphe* minute at base of seed. *Chalazal* opening basal covered by raphe. *Placental endocarp* membranous, caducous. (Figure 10)

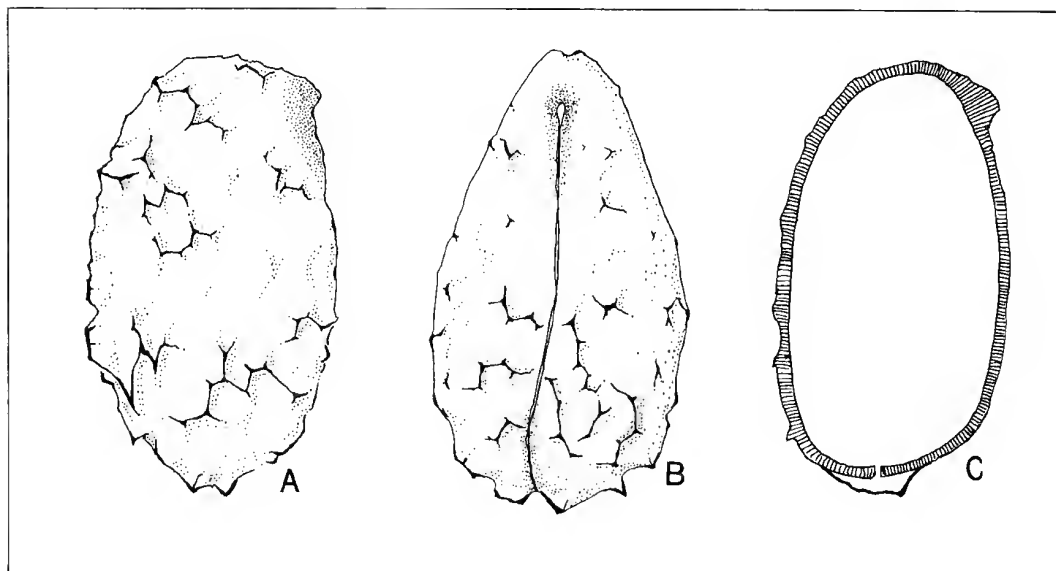


Figure 10. *Boronia coerulescens* seed. A - lateral view, B - adaxial surface, C - longitudinal radial section. all x20. Drawn from P.G. Wilson 270.

*Species examined.* Of the nine Western Australian species that are recognized in this section the following seven were examined for seed characters: *Boronia baeckeacea*, *B. busselliana*, *B. coerulescens*, *B. fabianoides*, *B. inconspicua*, *B. penicillata*, and *B. ramosa*.

*Notes.* The seed in this section is fairly uniform, except for variation in size. The rugose testa, black with powdery grey between the ridges, makes the seed unique in the genus and enables the section to be readily recognized.

***Boronia acanthoclada* Paul G. Wilson, *sp. nov.***

Fruticulus effusus c. 30 cm altus; ramuli divaricati, spinescentes, minutissime puberuli. Folia alterna, sace in ramis veteribus fasciculata, angustissime obovata, 3-6 mm longa, supra concava, crassa, glabra. Flores solitarii, ad ramulos breves terminales; pedicellus supra bracteolas breves gracilis, 2-3 mm longus. Sepala anguste triangularia, 1.5-2 mm longa, carnosae, glabra. Petala elliptica, c. 4 mm longa, glabra, alba.

*Typus:* Frank Hann National Park, Western Australia, 29 September 1984, J.M. Brown 4051555 (*holo:* PERTH 01258494).

Spreading *shrub* c. 30 cm high, divaricately branched. *Branchlets* spinescent, extremely minutely puberulous. *Leaves* alternate, often fasciculate on the older wood, very narrowly obovate, rounded below, concave above, 3-6 mm long, thickened, glabrous or almost so. *Flowers* solitary, terminal to short shoots; pedicel (above the small bracteoles) slender, 2-3 mm long. *Sepals* narrowly triangular, 1.5-2 mm



long, fleshy, glabrous. *Petals* elliptic, c. 4 mm long, with a thickened inflexed tip, glabrous, eciliate, glandular-punctate around midnerve, white. staminal filaments narrowly oblong, glandular-verrucose in upper half, ciliate; anthers c. 0.5 mm long, shortly and bluntly white-apiculate. *Disc* glabrous. *Ovary* glabrous; style slender-terete, c. 1.2 mm long, glabrous; stigma minute. *Fruit* not seen. (Figure 11)

*Specimens examined.* Known only from the type collection.

*Distribution.* Frank Hann National Park, c. 30 km east of Lake King, Western Australia.

*Habitat.* The collector's notes indicate that the plant was growing in sand over gravel.

*Conservation status.* Only known from the one collection which was collected in Frank Hann National Park; it has not been relocated although searched for on several occasions. A Priority Two conservation code appears to be appropriate.



Figure 11. *Boronia acanthoclada* A - branch, B - flowering branch, C - adaxial surface of leaf, D - flower, E - petal, F - sepaline and petaline stamens, G - disc and pistil. Scale bars: 10 mm (A), 3 mm (B,D), 2 mm (C,E), 1 mm (F,G). Drawn from holotype.

*Etymology.* The epithet is derived from the latinized Greek words *acantho-*, spiny, and *cladus*, a branch.

*Notes.* This species is most closely related to *B. coerulescens*. The presence of alternate leaves, although not unique, is unusual in the genus as are the spinescent branchlets. It is similar in appearance to some variants of *B. coerulescens* subsp. *spinescens* but differs in the shape of the leaves and in their alternate phyllotaxy.

**Boronia baeckeacea** F. Muell., *Fragm.* 4:28 (1863).

*Distribution.* Found in southern Western Australia from Pingrup east to Mt Ragged.

*Notes.* Two subspecies are recognized.

Leaves simple, erect, suborbicular, 2-3 mm long ..... subsp. **baeckeacea**

Leaves simple or trifoliolate,  $\pm$  spreading, broadly elliptic to obovate, 4-7 mm long ..... subsp. **patula**

**Boronia baeckeacea** F. Muell. subsp. **baeckeacea**

*Leaves* simple, suborbicular, concave,  $\pm$  appressed to branch, 2-3 mm long.

*Distribution.* Found in southern Western Australia from Pingrup east to Mt Ragged.

*Habitat.* Recorded as growing in a variety of situations, over granite or limestone or in heavy soil.

**Boronia baeckeacea** subsp. **patula** Paul G. Wilson, *subsp. nov.*

Folia  $\pm$  patula, ad apicem recurva, simplicia et integra vel tri-lobata vel trifoliolata; lamina circularis et c. 3.5 mm longa, vel obovata et 5-7 mm longa, supra profunde concava.

*Typus:* About 45 km north-west of Clyde Hill, Western Australia, 21 May 1993, G.F. Craig & B. Haberley 2773 (*holo:* PERTH 3218600).

*Leaves*  $\pm$  spreading, somewhat recurved at apex, sessile, simple and entire or 3-lobed, or trifoliolate; lamina circular and c. 3.5 mm long, to obovate and 5-7 mm long, deeply concave.

*Distribution.* Found in the vicinity of Mt Ney and Mt Heywood, c. 90 km north-east of Esperance, south-east Western Australia.

*Habitat.* Growing on clay-loam in mallee.

*Selected specimens examined.* WESTERN AUSTRALIA: 1 km W of Mt Heywood, K. Newbey 8279 (PERTH); SW of Mt Ney, A.S. George 15905 (PERTH); 26.5 km NE of Mt Heywood, W.R. Archer 1708912 (PERTH).

*Conservation status.* The collections all come from two relatively small areas and no attempt has been made to determine its degree of security. A Priority One rating would appear to be appropriate.

*Etymology.* The subspecific epithet is derived from the Latin word *patulus*, spreading, referring to the posture of the leaves.

*Notes.* This subspecies has circular or obovate leaves to 7 mm long. Occasionally some of these leaves are divided into three sessile leaflets with such a variation being found on the same branch. It grades to the south and west into the typical subspecies.

***Boronia coerulescens*** F. Muell., Trans. Phil. Soc. Victoria 1: 11 (1854). *Type:* Mallee scrub near the entrance of the Murray, South Australia, September 1848, *F. Mueller* (lecto: MEL 1058497), lectotype here chosen.

*Typification.* Mueller gave no collection data under the species name but only under the two varieties, var. *pubescens* and var. *glabrescens*, of which the latter is so lectotypified as to make it homotypic with the typical variety.

***Boronia coerulescens*** F. Muell. subsp. ***coerulescens***

*B. coerulescens* var. *glabrescens* F. Muell., Trans. Phil. Soc. Victoria 1: 11 (1854). *Type citation:* In barren places from the Mallee scrub on the Murray River to Spencer's Gulf. *Type:* Mallee scrub near the entrance of the Murray, South Australia, September 1848, *F. Mueller* (lecto: MEL 1058497), lectotype here chosen.

*B. coerulescens* var. *pubescens* F. Muell., Trans. Phil. Soc. Victoria 1: 11 (1854). *Type citation:* On rocky hills in the Grampians, and in the desert towards Guichen Bay. *Type:* Morro Morro, The Grampians, Victoria, November 1853, *F. Mueller* (MEL 1058495; *isolecto:* MEL 1058494), lectotype here chosen.

*Distribution.* This subspecies occurs in extreme south-eastern New South Wales, eastern Victoria through southern South Australia and southern Western Australia.

***Boronia coerulescens*** subsp. ***spicata*** Paul G. Wilson, Nuytsia 1: 200 (1971).

*Distribution.* Occurs in inland southern Western Australia from Paynes Find south to Muntadgin and east to near Coolgardie.

***Boronia coerulescens*** subsp. ***spinescens*** (Benth.) Paul G. Wilson, Nuytsia 1: 200 (1971).

*B. spinescens* Benth., Fl. Austral. 1: 319 (1863). *Type:* Swan River Colony, Western Australia, *J. Drummond* 87 (*holo:* K; *iso:* MEL 236848).

*Typification.* The Drummond collection was incorrectly cited by Bentham, *loc. cit.*, as 78.

Bentham evidently studied two collections of James Drummond's when describing this taxon both of which were in the Herbarium Hookerianum (now herb. K). On the sheets of each collection the epithet *spinescens* is underlined in red ink, which procedure was used by Bentham to indicate that he had studied the specimen when writing the Flora of Australia (Bentham 1863). One of the collections, number 87, is of a plant that is making fresh growth from a burnt stump, it has ascending scarcely spinescent branches. The other, which is not numbered, has spreading prominently spinescent branches. Evidently Bentham derived the specific epithet from the branching pattern of the unnumbered collection but since only collection 87 was cited by him the unnumbered one is not available for lectotypification.

**Boronia fabianoides** (Diels) Paul G. Wilson, Nuytsia 1: 119 (1970). - *Eriostemon fabianoides* Diels, Bot. Jahrb. Syst. 35: 322, tab. 39 K-L (1904). *Type*: North of Grasspatch, Western Australia, 2 November 1901, L. Diels 5289 (iso: PERTH 01609726).

*Distribution*. Found near Cowcowing and from Lake King east to the Fraser Range, southern Western Australia.

*Notes*. Two subspecies are recognized.

Petals *c.* 3 mm long, white with green midrib ..... subsp. **fabianoides**

Petals 5-7 mm long, white with pink midrib ..... subsp. **rosea**

**Boronia fabianoides** (Diels) Paul G. Wilson subsp. **fabianoides**

Low spreading *shrub* with divaricate branches, 10-30 cm high. *Sepals* triangular, *c.* 1 mm long. *Petals* broadly elliptic, *c.* 3 mm long, 2 mm wide, glabrous, white with thickened green midrib.

*Distribution*. Norseman to Esperance area of southern Western Australia.

*Habit*. In eucalypt woodland on brown loam, sometimes calcareous.

*Notes*. This subspecies generally has hispidulous branchlets but a glabrous variant is found *c.* 70 km east of Norseman along the Eyre Highway (*G.F. Craig* 3064; *R.J. Cranfield* 9384).

**Boronia fabianoides** subsp. **rosea** Paul G. Wilson, *subsp. nov.*

Fruticulus erectus ramis ascendentibus, 30-60 cm altus. Sepala triangularia, 2(3) mm longa. Petala late elliptica, 5-7 mm longa, glabra, alba praeter costam crassam pallido rubram.

*Typus*: Woodline, *c.* 95 km east-north-east of Norseman, Western Australia, 7 August 1980, *G.J. Keighery* 2998 (*holo*: PERTH 942294).

Erect *shrub* with ascending branches, 30-60 cm high. *Sepals* triangular, 2(3) mm long. *Petals* broadly elliptic, 5-7 mm long, 4-6 mm wide, glabrous, white with a thickened narrow pink midrib.

*Selected specimens examined*. WESTERN AUSTRALIA: 10 km E of Norseman, *D.E. Albrecht* 4035 (PERTH); Cowcowing, September 1904, *M. Koch* 1231 (MEL); 30 km S of Norseman, *K. Newbey* 6869 (PERTH); 2.5 km NW of Lake Cronin, *K. Newbey* 8311 (PERTH).

*Distribution*. Found between Lake King and the Fraser Range, Western Australia, with a 1904 record from Cowcowing.

*Habitat*. In clay-loam often over greenstone or granite.

*Etymology*. The subspecific epithet *rosea*, from the Latin, *roseus*, refers to the colour of the broad midrib of the petals.

*Notes.* This plant has been described by one collector as being pungently aromatic with a spearmint scent, and by another as having a menthol smell when crushed.

The single collection from the Cowcowing district, made in September 1904 (*M. Koch* 1231), has narrow-oblong sepals *c.* 3 mm long and prominent white anther apicula, but it otherwise agrees with the more easterly collections of subsp. *rosea*.

***Boronia penicillata*** Benth., Fl. Austral. 1: 322 (1863). *Type:* Between Swan River and King George Sound, Western Australia, *J. Drummond* 98 (*lecto:* K, photo seen; *isolecto:* MEL 1058515), lectotype here chosen.

*Typification.* The sheet bearing the lectotype at herb. K is numbered 86 whereas the isoelectotype in herb. MEL has an original number tag that is fixed to the sheet so as to give the number 98. Comparison with the writing of the numbers 8, 6, and 9 by Drummond on tags of his other collections suggest that 98 is correct.

***Boronia ramosa*** (Lindl.) Benth., Fl. Austral. 1: 320 (1863). - *Cyanothamnus ramosus* Lindl., Sketch Vcg. Swan R. 18 (1839). *Type:* Swan River Colony, Western Australia, 1839, *J. Drummond* (*syn:* CGE photo seen); *Capt. Mangles* (*syn:* CGE, photo seen).

*Notes.* Three subspecies are recognized.

- 1 Pedicels 6-15 mm long; stigma fusiform or cylindrical ..... subsp. **ramosa**
- 1: Pedicels 2-3 mm long; stigma capitate
- 2 Leaflets slender terete, channelled above ..... subsp. **anethifolia**
- 2: Leaflets linear to narrowly oblong, concave above ..... subsp. **lesueurana**

***Boronia ramosa*** (Lindl.) Benth. subsp. **ramosa**

*Distribution.* The Darling Range from Perth north to Dandaragan and also near Mt Peron, Western Australia.

***Boronia ramosa*** subsp. **anethifolia** (Bartl.) Paul G. Wilson, Nuytsia 1: 320 (1863). - *Cyanthothamnus anethifolius* Bartl. in Lehm., Pl. Preiss. 1: 170 (1844). - *B. ramosa* var. *anethifolia* (Bartl.) Benth., Fl. Austral. 1: 320 (1863). *Type:* Near Spitesbrook on Canning River, 14 July 1841, *L. Preiss* 2035 (*lecto:* LD; *isolecto:* MEL 1058481, MEL 1058482), lectotype here chosen.

*Distribution.* Murchison River south to the Stirling Range and east to Cape Le Grand, Western Australia.

***Boronia ramosa*** subsp. **lesueurana** Paul G. Wilson, *subsp. nov.*

Folia pinnatim 3-5-foliolata, 15-40 mm longa; petiolus gracilis, 10-15 mm longus, supra sulcatus; foliola linearia vel anguste oblonga, 5-25 mm longa, obtusa, supra concava.

*Typus:* 3 km south-east of Shaw Rd on south boundary of [Mount Lesueur] reserve, Western Australia, 1 July 1992, *R.J. Cranfield* & *P. Spencer* 8245 (*holo:* PERTH 02241838).

Compact woody *perennial* to 30 cm high. *Branches* narrowly 4-winged when young due to the decurrent bases of the leaves, becoming tetragonal or terete with age, puberulous between wings otherwise glabrous; internodes 8-15 mm long. *Leaves* pinnately 3-5-foliolate, in all 15-40 mm long; petiole slender, 10-15 mm long, channelled above; leaflets linear to narrowly oblong, 5-25 mm long, 1.3-2 mm broad, obtuse, concave above.

*Other specimens examined.* WESTERN AUSTRALIA: 10 km N of Jurien Bay turn-off, R.J. Cranfield 1467 (PERTH); Mt Lesueur, C.A. Gardner 9081 (PERTH); Mt Lesueur, E.A. Griffin 1838 (PERTH).

*Distribution.* Recorded from near Mt Lesueur, c. 200 km north of Perth, south-west Western Australia.

*Habitat.* Grows in sand or gravel over laterite.

*Conservation status.* This subspecies is known from four populations of which at least one is in a national park. A Priority Two ranking is recommended.

*Etymology.* This subspecies is named after the hill where it is to be found.

*Notes.* *Boronia ramosa* subsp. *lesueurana* appears to grade into *B. ramosa* subsp. *anethifolia* which is found in the heathland surrounding Mt Lesueur; the most obvious difference between the two taxa is to be found in the shape of the leaflets which in subsp. *anethifolia* are slender-terete.

***Boronia westringioides*** Paul G. Wilson, *sp. nov.*

Ramuli stellato pubescentes. Folia conferta, ascendunt, opposita, semiteretia, acuta, 5-10 mm longa. Flores solitarii; pedicellus turbinatus, 1-2 mm longus, dense stellato pubescens; bracteolae foliaceae, c. 1.5 mm longae. Sepala triangularia vel ovato acuminata, 2-3 mm longa, crassa, sparse pubescentia. Petala elliptica, 5-6 mm longa, manifeste rubro glanduloso punctata, tenuia, modice stellato pubescentia.

*Typus:* 8 km west of Forrestania-Southern Cross road on Hyden-Norseman road, Western Australia, 12 October 1995, G.F. Craig 3318 (*holo:* PERTH 04202104; *iso:* CANB, K).

Erect *shrub* to 75 cm high with ascending branches. *Branchlets* stellate pubescent. *Leaves* sometimes congested, ascending, opposite (or ternate, or the leaves sessile and trifoliolate), semiterete or narrowly elliptic, channelled or concave above, acute, 5-10 mm long, smooth, glabrous or stellate puberulous. *Flowers* solitary in uppermost leaf-axils; pedicel turbinate, 1-2 mm long, densely stellate pubescent and with short clavate glandular hairs; bracteoles medially positioned, foliaceous, c. 1.5 mm long. *Sepals* triangular to ovate-acuminate, 2-3 mm long, thick, with prominent red glandular dots when dry, sparsely pubescent. *Petals* elliptic, 5-6 mm long, with prominent red glandular dots all over, thin, moderately stellate pubescent and with clavate glandular hairs, pale pink, midrib not prominent. *Staminal filaments* compressed terete, glandular tuberculate towards apex, ciliate; anthers minutely white-apiculate. *Ovary* glabrous or puberulous; style terete, c. 0.5 mm long, sparsely pilose; stigma subcapitate. *Seed* ellipsoid, c. 3 mm long, rounded at apex and base; testa rugose, black with white deposit. (Figure 12)

*Other specimens examined.* WESTERN AUSTRALIA: 6 km W of junction of Forrestania Rd and road from Hyden, B. & B. Backhouse H/9 (PERTH); far inland from King George Sound, 1882, A.Y. Hassell (MEL); 7 km W of Lake Cronin, K. Newbey 5199 (CANB, PERTH); c. 65 km E of Hyden, K. Newbey 9169 (PERTH).

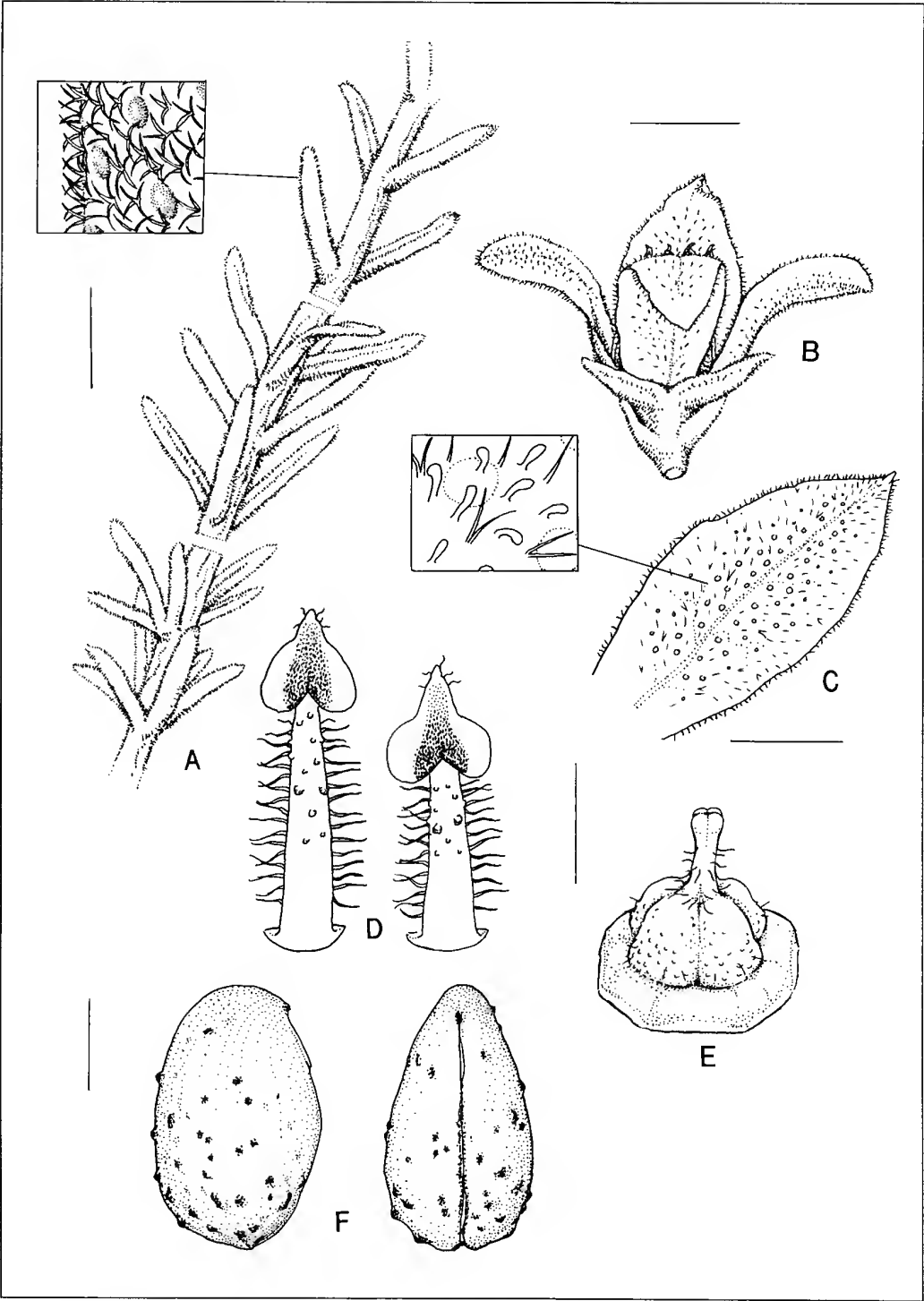


Figure 12. *Boronia westringioides* A - branch, B - flower, C - petal (abaxial surface), D - sepaline and petaline stamens, E - disc and pistil, F - lateral and adaxial surfaces of seed. Scale bars: 5 mm (A), 3 mm (B), 2 mm (C), 1 mm (D,E and F). Drawn from D. Papenfus 494.

*Distribution.* Known from a small area c. 70 km north of Lake King township and c. 65 km east of Hyden, in southern inland Western Australia.

*Habitat.* Recorded as growing on loamy sand plains.

*Notes.* There is some variation in the leaves. Whereas in most collections they are simple and decussate in two collections they are ternate with some of the leaves sessile and trifoliate.

*Conservation status.* This species warrants a Priority Two ranking since it is known from only one area which is not currently under threat.

*Etymology.* The epithet alludes to the plant's resemblance to members of the genus *Westringia*.

*Affinities.* This species differs from its closest relative, *B. baeckeacea*, principally in its leaf shape.

### Acknowledgements

The illustrations were kindly prepared by my daughter Annemarie. Material was borrowed from the National Herbarium of Victoria (MEL), Royal Botanic Gardens, Kew (K), Trinity College, Dublin (TCD), Botanic Gardens of Adelaide (AD), and the Botanical Museum, Lund (LD); I am grateful to these herbaria for their assistance. This work was partly funded by a grant from the Australian Biological Resources Study.

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## SHORT COMMUNICATION

*Illecebrum verticillatum* (Caryophyllaceae), a new record for Australia

In October 1996 a small alien herb, *Illecebrum verticillatum* L., was found on Big Rock, near Dunsborough, Western Australia. It was collected by Ralf Ohlemueller (*Ohlemueller* 252), a visiting botanist from Munich, who was studying the plants occurring on granite outcrops in this State. According to his recollection the plant covered several square metres near the top of the granite hill and grew in a mossy sward. Given that it is evidently well established at this one locality, and its rather insignificant appearance, it is likely that the plant occurs in other sites in the south west of Western Australia that have a similar environment.

It is considered rare in England where it "forms prostrate mats several inches in diameter on damp heathy ground, particularly where the soil has been disturbed" (Gilmour & Walters 1954) and has been given the "common" name *Illecebrum*. Other common names listed in some European plant books are Whorled Knotweed (Hutchinson 1955) and Coral Necklace (Hanf 1983, Martin 1982), although it is unclear as to whether any of these names are truly in common usage.

No record can be found of any previous discovery of this species in Western Australia or, in fact, in Australia. In New Zealand it has been found in only one locality and that was in a forest on a damp sandy open site (Webb *et al.* 1988). Its natural distribution is western, central, and southern Europe (Kubitzki 1993).

This plant has only been noted as a weed of native vegetation in Australia and New Zealand but it might become a minor agricultural weed in Western Australia since it is recorded as a weed of damp arable sites on sandy and marshy soils throughout its range in Europe (Hanf 1983).

*Illecebrum* is a monotypic genus that has been placed sometimes in the Caryophyllaceae (e.g. Eckardt 1964) and sometimes in the segregate family Illecebraceae (e.g. Friedrich 1961). The Western Australian Herbarium follows Kubitzki *et al.* (1993), the most authoritative recent treatment of the caryophyllid families, and places it in the Caryophyllaceae subfamily Paronychioideae.

Illustrations of the plant may be found in Fitch & Smith (1880: Figure 833), Hanf (1983: Figure 66), Hutchinson (1955: Figure 401), Martin (1982: Plate 71), and Ross-Craig (1968: Plate 7).

According to Lewis & Short (1966) the Latin word *illecebra* means an enticement, in a good or bad sense; it was also used for a plant to which the Romans applied the alternative name *andrachne agria*. The name *andrachne* itself referred to the common weed *Portulaca oleracea*. Both *Portulaca oleracea* and *Illecebrum verticillatum* are unlikely candidates for an "enticement" and it is difficult to understand how this word could have become applied to them. It is more likely that the Romans had other plants in mind when using the name and that the identity of these is now lost.

## Acknowledgements

Dr Jonathan Dodd, of Agriculture Western Australia, when refereeing this paper contributed some useful points and materially added to the references.

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## CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

### **R: Declared Rare Flora - Extant Taxa (= Threatened Flora = Endangered + Vulnerable)**

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

### **X: Declared Rare Flora - Presumed Extinct Taxa**

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.

#### **1: Priority One - Poorly Known Taxa**

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

#### **2: Priority Two - Poorly Known Taxa**

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

#### **3: Priority Three - Poorly Known Taxa**

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

#### **4: Priority Four - Rare Taxa**

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

## Notes for Authors

The aim of *Nuytsia* is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide discs readable directly by IBM computer or internet attachments. Wherever possible, the MS-WORD software should be used. Original figures should not be lettered but accompanied by copies indicating lettering. Page proofs will be forwarded to authors for checking. Twenty reprints of each paper will be provided free of charge; no additional copies may be ordered.

Style and layout should follow recent numbers of *Nuytsia*. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Italics should be used for formal taxonomic names, from the genus level down to the lowest infraspecific categories, and for collectors' names when citing specimens. Incidental Latin words in the text should be italicized but not the Latin diagnosis.

*Title.* Should include the family name of the genera or species treated, but not authorities. New taxa should be named if not too numerous. The type of paper (e.g. revision, synopsis) and geographic area of study should be given where appropriate.

*Structure of papers.* Authors are encouraged to use the conventional structure of scientific papers, especially when a complete study, such as a revision, is being reported.

(1) *Abstract.* Should be indented and commence with bibliographic information. New taxa, combinations and names should be listed with their authorities. The major contents of the paper should be concisely summarized but no additional material given.

(2) *Introduction.* Should give some background information and state the purpose of the paper.

(3) *Methods or Materials and methods.* May include the method of drawing up the description from specimens, extent of search for types and discussion of concepts of taxonomic categories.

(4) *Results or Taxonomy or Taxonomic treatment* or various alternative headings as appropriate to the data being presented in the paper.

(5) *Discussion.* A discussion section should be considered, which would include some or all of the following: a summary of the findings emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

*Short Communications.* These are short concise contributions, usually with few or no main headings. They lack an abstract and authors' names and addresses are placed at the end.

*Headings.* All headings should be mainly in lower case, major headings centred and bold, secondary headings (where required) left-justified and bold, and minor headings left-justified and italicized.

*Keys.* May be either indented (e.g. *Nuytsia* 11: 94) or bracketed (e.g. *Nuytsia* 11: 55-56). Indented keys involving more than nine levels of indentation should be avoided. Where a key is indented, tabs should be used and not space bars.

*Species treatments.* Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Italicized headings should be followed by text on the same line.

(1) Taxon name (in bold) and authority. For previously published taxa this should be followed by the reference, nomenclatural synonyms (if any) and *Type:* heading with full type details.

(2) Other synonyms with their type details, significant manuscript or phrase names. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

(3) Latin diagnoses (for new taxa - not indented).

(4) *Typus*: (for new taxa - not indented).

(5) English description (indented).

(6) *Other specimens examined* or *Selected specimens examined* as appropriate. The number of specimens cited for each taxon should not exceed 20. Western Australian specimens should be cited first followed by any from other states in the order: Northern Territory, South Australia, Queensland, New South Wales, Victoria, Tasmania. Within each region, the specimens cited should be placed in alphabetical order according to the collectors' surnames. For each specimen the order of the details given should be as follows: locality, date, collector's name (in *italics*) and number, herbarium (in brackets).

(7) *Distribution*.

(8) *Habitat*.

(9) *Phenology* or *Flowering period*.

(10) *Conservation status*. Department of Conservation and Land Management Conservation Codes for Declared Rare and Priority Flora should be cited for any endangered or rare Western Australian plants.

(11) *Etymology*.

(12) *Typification*.

(13) *Affinities*.

(14) *Notes* or *Discussion* or *Comments*.

*Threatened species*. The Department of Conservation and Land Management has a policy not to publish precise locality data for threatened species. When describing threatened taxa authors are therefore requested to use generalized localities accompanied by the bracketed statement [precise locality withheld].

*Standard abbreviations*. When abbreviations are used, the following standards should be followed.

(1) Author abbreviations. Follow Brummitt, R.K. & Powell, C.E. (1992). "Authors of Plant Names." (Royal Botanic Gardens: Kew.).

(2) Book titles. These should not be abbreviated in the references but any literature citations in the text should follow Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." Edn 2. pp. 20-24. (Department of Agriculture: Perth.). A more complete list of book title abbreviations is given in Stafleu, F.A. & Cowan, R.S. (1976-83). "Taxonomic Literature." Edn 2. (Bohn, Scheltema & Holkema: Utrecht.), but capital initial letters need to be used in *Nuytsia*.

(3) Journal titles. Follow Lawrence, G.H.M. *et al.* (1968). "B-P-H, Botanico-Periodicum-Huntianum." (Hunt Botanical Library: Pittsburgh.)

(4) Dates and directions. Generally should not be abbreviated except under the *Specimens examined* section. In that section, dates should be written in full only if they have less than five letters (e.g. July), otherwise should be shortened to the first three letters and a stop (e.g. Oct.), while compass directions should be abbreviated to capital letters with no stops (e.g. N and SSW).

(5) Other abbreviations. Standard abbreviations for measurements (e.g. mm), Latin abbreviations (e.g. *c.*, *nom. illeg.*), mountains and roads (e.g. Mt Kosciuszko, Brooke Rd) are used in *Nuytsia*. Other abbreviations, especially ones that are ambiguous (e.g. Pt), should be avoided.

*Figures*. Numbers should follow a single sequence including maps.

*References*. Citation of references in the text should give the author's surname and date (e.g. Smith 1963) and full details should be given in the reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Benth. (Bentham 1878: 234) rather than Benth., Fl. Austral. 7: 234 (1878).



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